June 1940

TECHNOLOGY REVIEW

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GREETINGS

For NINETY-NINE YEARS the activities of the Badger organization have covered a wide range of processing projects that have taken their engineers to the four corners of the earth.

Badger engineers have been associated with the development of many processes of far reaching economical importance, the latest being the Houdry catalytic processes for the petroleum industry.

E. B. Badger & Sons Co. greets the returning graduates on M.I.T. Alumni Day, June 3, 1940.

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J. R. Minevitch	1916
B. R. Rosenberg	1916
H. W. Hatch	1918
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H. C. Moberg	1919
H. G. Bower	1920
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A. J. Connell	1928
J. S. Carey	1930
J. J. Brown	1933
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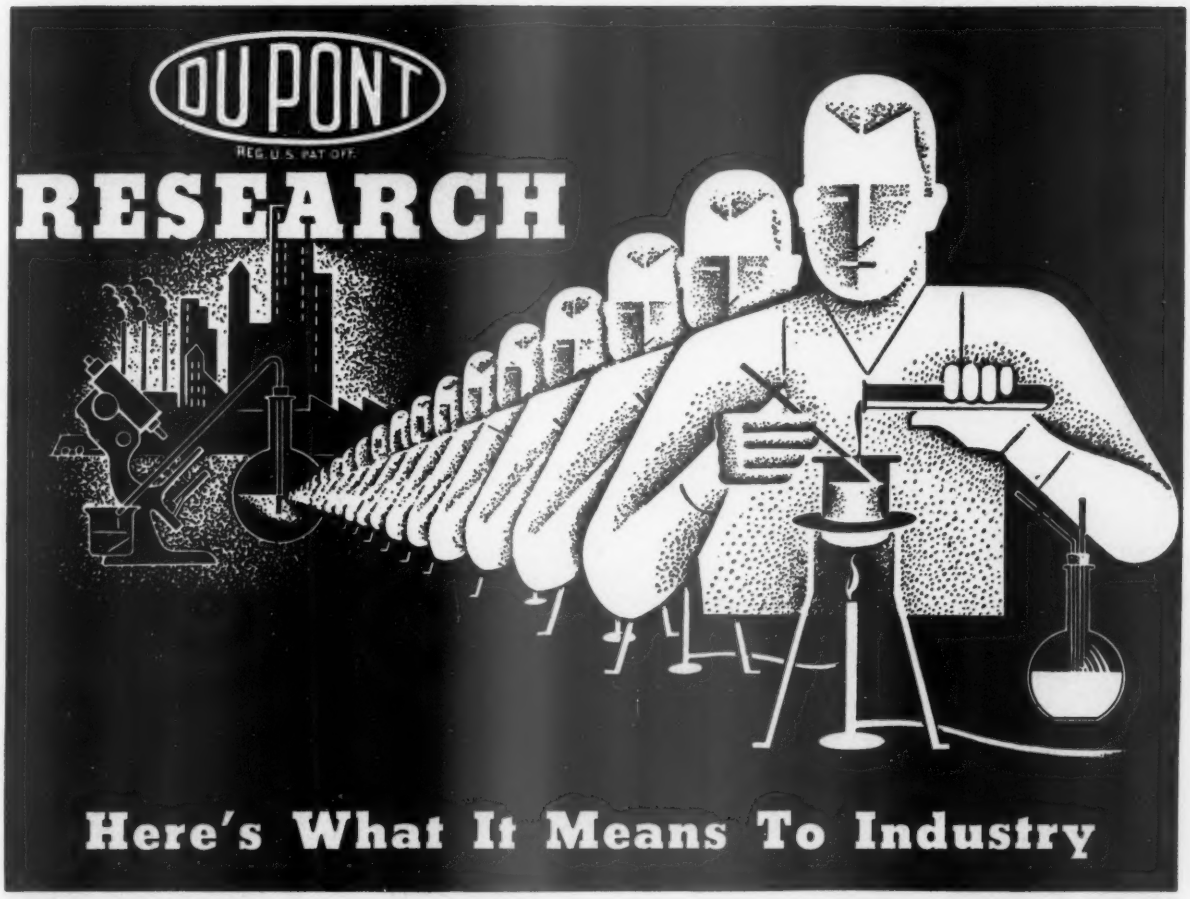
V. P. Cook	1935
W. C. Rousseau	1935
M. W. Shellenbarger	1935
R. E. Sawyer	1936
G. A. Randall	1937
Margaret Hutchinson Rousseau	1937
T. B. Oakes	1938
J. M. Chambers	1939
J. C. Starr	1940

THE TECHNOLOGY REVIEW, June, 1940. Vol. XLII, No. 8. Published monthly from November to July inclusive at 10 Ferry Street, Concord, N. H. Publication date: twenty-seventh of the month preceding date of issue. Annual subscription $3.50; Canadian and Foreign subscription $4.00. Entered as second-class matter at the Post Office at Concord, N. H., under the Act of March 3, 1879.



SINCE its very beginning the du Pont Company has emphasized the importance of extensive, scientific research, both fundamental and applied. It has backed up its faith in research by maintaining large laboratories. In these laboratories groups of scientists are constantly working, in good times and bad, developing new lines of products, improving products in the old lines, checking up and modernizing old processes and providing new ones.

Every branch of industry, and the ultimate consumer, too, benefits by this extensive research. The objective is chemicals and materials which are cheaper, better, more easily worked to help manufacturers to reduce their costs, and improve their products. Better materials at lower costs enable manufacturers to develop and expand consumer markets, to make available to more people more of the better things for better living.

Du Pont research is carried on for industry in general. New products and new uses can't be picked out of the air. New industries don't "just happen." They are the result of planned research, planned development far in advance, a careful groundwork of today to create the things which may be required to meet the needs and conditions of one, five, ten and even twenty years later.

The answer to what du Pont research means to industry rests with hundreds of improved products and processes which are now in use in a wide variety of industries, by the support which industry has given du Pont, thereby enabling it, not only to carry on, but to broaden its research activities.

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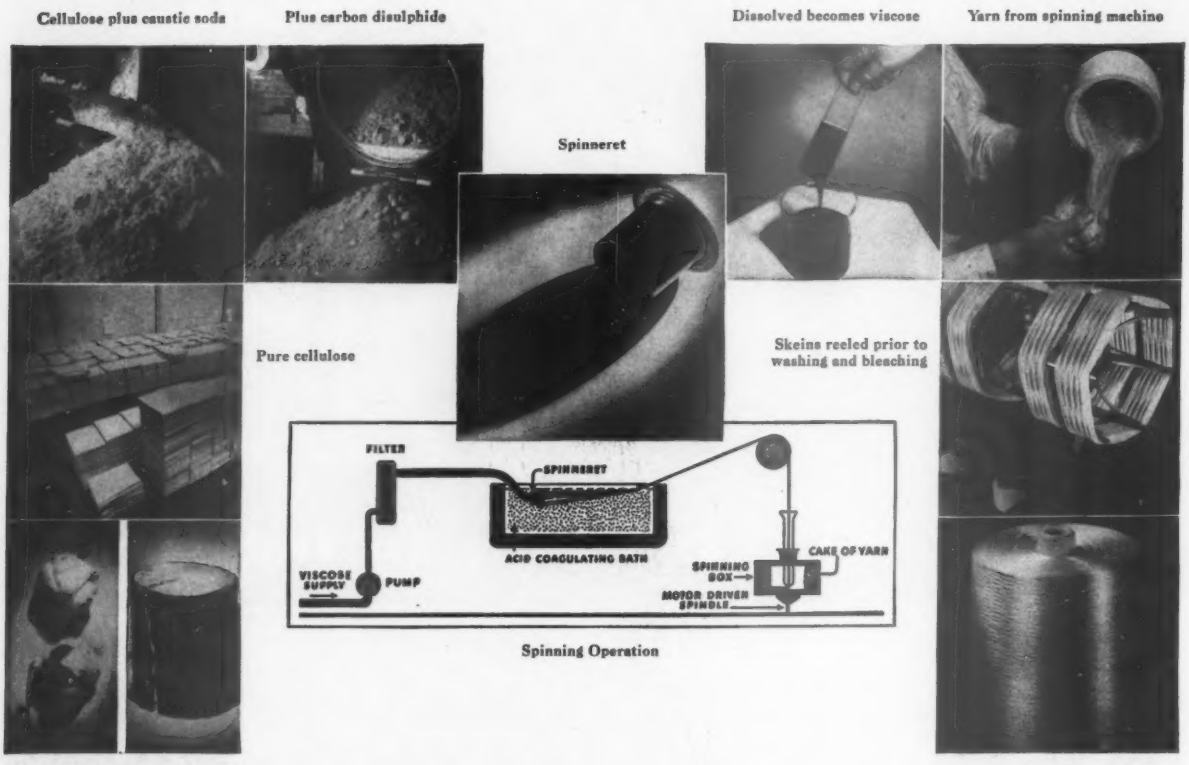
RAYON... *from start to finish*



Viscose Rayon undergoes the following steps, from pulp to finished fibre:

1. Cellulose from specially treated wood pulp or cotton goes into a mill in "sheets" or baled loose pulp. These are...

2. Steeped in a mercerizing solution, broken up and...

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4. Treated chemically, to make it soluble. It then becomes a liquid, called viscose, and it is ready for the...

5. Spinneret. It is forced through minute perforations, forming fine filaments or threads, which harden in a coagulating bath; and many filaments are twisted into yarn by a revolving spindle.

Constantly tested for uniformity, at every stage, rayon yarn is shipped to fabric mills either in skeins or on cones or spools, ready to be placed directly on spindles or looms.

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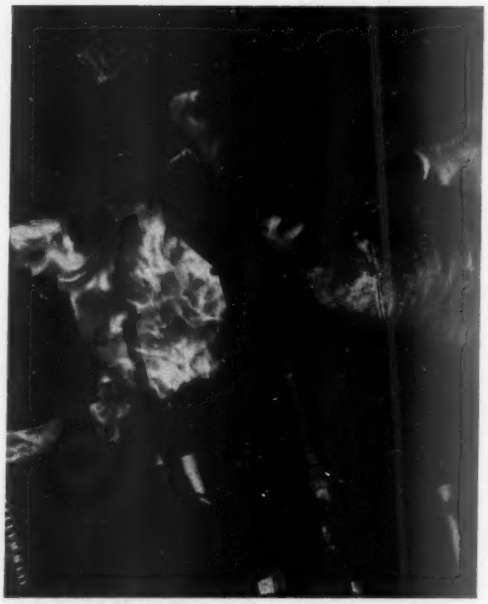
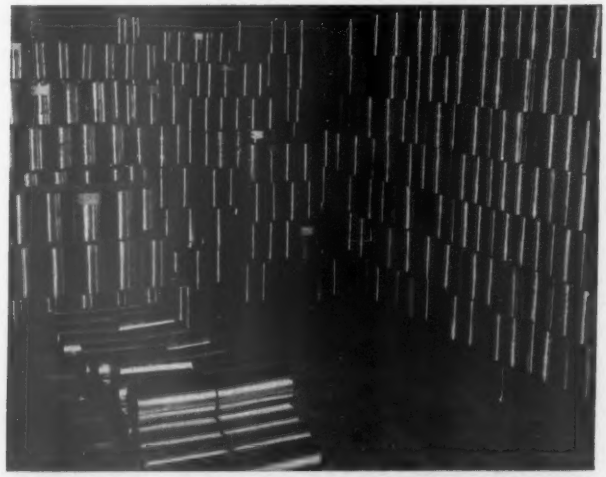


VERTICAL EXTRUSION OF NON-FERROUS BASE SIZES FOR CONDENSER TUBES AT WOLVERINE TUBE COMPANY

CONDENSER TUBES . . .

IF YOU could only "wish" heat-exchanger tubes into your jobs just the way you want them — proper specifications conscientiously adhered to; best modern equipment for manufacturing; constant production control of physical properties; 100% inspection by men who are experts — if this were only possible, you would probably say to yourself, "There is the company for my tube business!" Let us hear from you.



CASTING PRACTISE AT WOLVERINE IS THE RESULT OF MANY YEARS OF EXPERIMENT AND PRODUCES THESE BILLETS FOR THE EXPRESS PURPOSE OF EXTRUDING NON-FERROUS TUBES

WOLVERINE TUBE COMPANY

DETROIT MICHIGAN

Seamless Copper and Brass Tubing

GEORGE R. ANTHONY '98, *Vice-President*

REUNION PROGRAM

May 31, June 1–4

Class Reunions: For scheduled reunions and meetings of classes during the reunion period, see page 332. Ask your Class Secretary for complete details.

JUNE 2

6:30 P.M. President Compton's supper for Honorary Secretaries, officers of Technology clubs, and Alumni Fund class agents. Engineers Club, 2 Commonwealth Avenue, Boston. Informal dress.

JUNE 3
ALUMNI DAY AT TECHNOLOGY

Morning

8:30 A.M.–10:00 A.M. Registration for Alumni and their wives in the Rogers Lobby. Tickets previously ordered may be obtained at the registration desk. There will be a registration charge of $1.50 for those not purchasing blanket tickets. Payment of this registration charge will permit Alumni to attend the Communications Conference and the Luncheon. *Tickets for these events cannot be purchased in advance of June 3 except by the purchase of a $5.00 blanket ticket.*

10:00 A.M. Communications Conference, "Channels of World News and Opinion," Huntington Hall (Room 10–250). Admission by ticket only until 9:55 A.M.

Speakers

DR. FRANK B. JEWETT '03, *Presiding Officer*
President, Alumni Association
President, Bell Telephone Laboratories
Vice-President, American Telephone and Telegraph Co.

ALFRED H. MORTON, *Vice-President in Charge of Television, National Broadcasting Company; European Manager, Radio Corporation of America 1929–1934; Manager Program Department, National Broadcasting Company 1934–1937; Vice-President in Charge of N.B.C. Managed and Operated Stations 1937–1939*

"THE ROLE OF RADIO IN WORLD AFFAIRS"

JAMES H. FURAY, *Vice-President, United Press Associations; Member of the Association of Foreign Press Correspondents; Staff of the United Press Associations since 1908; Foreign Editor 1918–1924; General Foreign Manager 1924–1937*

"BEHIND SCENES IN THE WORLD OF NEWS GATHERING"

Exhibit

This program, together with extensive exhibits in both the Main and Rogers Lobbies, showing scientific progress in the transmission of information by wire and radio, offers Alumni an unexcelled opportunity to inform themselves about the rapid development in the field of communications. Included among the exhibits will be a teletype receiving up-to-the-minute press association dispatches, teletype-setter for setting type by wire, picture transmitter, ship-to-shore radio transmitter and receiver with radio compass, aviation radio receiver and transmitter with altimeter, and others.

Alumni Day 1940 will long be remembered by Tech men for these interesting exhibits, and bids fair to become one of the most fascinating and stimulating alumni conferences ever held.

Afternoon

12:30 P.M. Luncheon for all Alumni and their guests in Du Pont Court. Tickets required. Special tables for the 50th (1890) and the 25th (1915) reunion classes, and for their women guests.

2:00 P.M. Class Day Exercises in Lowell Court, featuring the Senior Class, and the Classes of 1890 and 1915.

Prominent speakers, including representatives of the Alumni Association, 50th year, 25th year, and Senior classes. During the Class Day ceremonies, the present Senior Class of 1940 is officially initiated to membership in the Alumni Association.

4:15 P.M. Dedication ceremonies of Technology's swimming pool, made possible by alumni, staff, and student endeavor. After the dedication, the pool building will be open for inspection by Alumni and their guests.

Evening

6:30 P.M. Banquet in honor of the Tenth Anniversary of Dr. Compton's inauguration. No speeches except a brief highlighting by Dr. Frank B. Jewett of the accomplishments at Technology since Dr. Compton became its President, and Dr. Compton's interesting annual report on the status of the Institute.

A treat of the evening will be a demonstration in sound (not a moving picture), known as the "Vocoder." Its inventor, Dr. Homer Dudley, will be present to entertain, to amuse, and withal to excite the interest of the technically minded.

When a Hollywood director recently heard the "Vocoder" transform a pipe-organ rendition of "The Bells of St. Mary" into the words of this song, he described the effect as an ethereal choir. This mechanical Pygmalion of sound, the "Vocoder," could transform a Vote 10 to a degree *cum laude;* it could even make the voice of Charlie Locke sound like Lily Pons!

Of course, there will be another attractive stein to add to your collection — obtainable only at the dinner.

Admission to seats at the banquet table will be restricted to former students, their male guests, and members of the Corporation and Staff who hold the $5.00 blanket tickets. No separate tickets for the dinner will be available. Seating will be by classes, and seats will be reserved by number. We cannot guarantee to seat you with your class unless your ticket application is received on or before June 1. Informal dress.

Tables will be provided for nonalumni members of the Corporation and Institute Staff.

Program for the Ladies — June 3

An interesting and entertaining program has been arranged for Alumnae and wives of Technology Alumni. The program:

8:30–10:00 A.M.	Registration in lobby of Rogers Building.
9:00–10:00 A.M.	Coffee served in Emma Rogers Room (10–340).
10:00 A.M.	Conference, "Channels of World News and Opinion."
12:30 P.M.	Luncheon in Du Pont Court.
2:00 P.M.	Class Day Exercises.
3:45–4:45 P.M.	Open House in the Forris Jewett Moore Room (6–321), Eastman Building.
5:00 P.M.	Motorboat Trip on Charles River Basin leaving from, and returning to, M.I.T. Sailing Pavilion in front of Walker Memorial.
6:30 P.M.	Dinner at the home of Mrs. Karl T. Compton, 111 Charles River Road, Cambridge.
8:00 P.M.	Busses leave the President's House for the Hotel Statler in time for program following men's dinner.

Tickets for ladies, covering Registration, Conference, Luncheon, Boat Trip, Ladies' Dinner at President's House, and the program following the men's dinner at the Statler, may be ordered with the men's blanket tickets at the nominal charge of $3.00. Separate luncheon tickets may be purchased on June 3 at $1.50; Ladies' Dinner tickets at $2.00.

REQUIREMENTS MET AND MONEY SAVED

Cast iron distributor gears for automotive engines have several recognized advantages. They are quiet, wear well, and are comparatively inexpensive. The problem is to produce a cast iron with the necessary wearing qualities and yet keep it machineable.

Several automotive engine manufacturers are now obtaining the necessary strength (50,000 p.s.i.) and hardness (250-300 B.H.N.) — and eliminating machining difficulties—by making distributor gears of Nickel-Chromium-Molybdenum iron. The machineability of the iron is largely a result of its Molybdenum content.

By specifying this machineable iron, engine builders can meet distributor gear requirements with regard to noise and wearing quality — and save money doing it.

Full technical details concerning Nickel-Chromium-Molybdenum iron and other cast irons serving the automotive field with efficiency and economy are found in our book "Molybdenum in Cast Iron." Sent free on request to any interested technical student.

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MOLY

No. 26

Just for Fun!

A CHALLENGE

TO YOUR INGENUITY

THE ends of a closed cylinder, fitted with a leakproof, frictionless piston, are filled with perfect gases having the initial pressures, volumes, and temperatures indicated. If all of the walls are perfect heat insulators, where will the piston finally stop?

A says: Where P=p, using adiabatic processes.
B says: The piston will oscillate perpetually.
C says: Even though heat does not flow *through* the piston, the piston itself will act like a big molecule, and [after many oscillations] the pressures *and temperatures* will equalize.
Who is right? Are there other possibilities?

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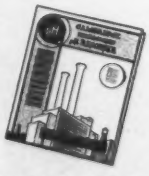

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THE TABULAR VIEW

AS physicist and as president of the Institute, KARL T. COMPTON has a clear comprehension of science corresponding well with the sincere appreciation of religion which he possesses as an honest and reflective thinker. Hence discussion by him of these two concepts and their interrelations (page 319) is of particular interest and penetration. ¶ A. H. PHILLIPS, whose account of some of the ciphers utilized for the transmission of secret intelligence in wartime (page 321) is somberly appropriate to the present, was a divisional intelligence officer in the British army during the war of 1914–1918. He has spent many years in the United States as a newspaperman and as a scenario writer in Hollywood. His wartime activities gave him much insight into the ways and means of secret agents. ¶ Surgeon general of the United States Public Health Service since April, 1936, THOMAS PARRAN, JR., has done a great deal to bring sharply into the public consciousness both the service and the objectives which it seeks. In this issue, The Review presents an article (page 323) in which Dr. Parran discusses deficiencies in the national diet, their consequences in the national health, and the effects on industry and agriculture which are to be expected if effort to supply the lacks is successful. Dr. Parran's article is drawn from the William Thompson Sedgwick Memorial Lecture which he delivered at Technology in April of this year. ¶ As the summer opens and the camera enthusiast senses the gradual approach of vacation days, he may be thinking of emulating those photographers whose portrayals of birds and beasts have in the past stirred his envy. One of the ablest of these gentlemen is HENRY B. KANE, '24, first Director of the newly established Alumni Fund, author, illustrator, and portrayer of wild life whose photographs have been widely applauded throughout the country. In this month's Review (page 326) Mr. Kane tells all, or nearly all, of the tribulations and the delights of this kind of photography and, in addition, he tells many of the specific devices and means which he has found to be successful in its practice. The amateur who wishes to go and do likewise will here find shrewd advice. ¶ CLARK S. ROBINSON, '09, Associate Professor of Chemical Engineering at Technology, was presented to The Review audience in February, when he discussed, in the light of his experience as chief of the ammunition division of the Boston District Ordnance Office, American needs for wartime materials. A distinctly different subject engages him in this issue (page 329). His essay upon the factual history of metals which underlies North European mythology commands interest on its own merits and is, in addition, a side light on lands unhappily prominent in war headlines.

TO the Cover Club, The Review welcomes PAUL M. WISWALL, '09, with a striking photograph of a native lighter on the Malabar Coast of India. Lashings rather than treenails secure the hulls of these vessels, whose multipatched sails are colorful and curved.

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MAIL RETURNS

LETTERS AND PICTURES FROM REVIEW READERS

Subdeb

FROM L. MAGRUDER PASSANO:

Airy fairy, Neu-tri-no,
Weighing nothing when you're slow,
Gaining weight when moving fast,
Tell us what you'll be at last.
When you move with speed of light
Will you be a "moving" sight
Like Lillian Russell or Mae West,
Broad of hip and full of breast?
Or like the circus lady fat
Whom as kids we wondered at,
Needing a whole couch to sit on,
With a shape no gown would fit on?
All our girls, though fast enough,
Still preserve that glamour stuff,
And however fast their gait
Never, never put on weight.
Don't, dear, get Gay Ninety's figger.
Have a heart and don't grow bigger.
Put the brake on. Red lights show.
Airy fairy, Neu-tri-no!

Brookline, Mass.

How to Do It?

FROM THOMAS L. HINCKLEY, '06:

Few students of our government will quarrel with the three specifics for our governmental ills outlined by Stuart A. Rice in the April Review. I wish, however, that Dr. Rice had carried his analysis one step farther and shown how these three objectives are to be reached. Beginnings along the lines indicated have, of course, been made in our manager-governed cities, in a number of counties, and in some states; the chief need would seem to be to determine how to accelerate this trend. The problem of how to speed up the process and at the same time be sure that we are not substituting new evils for those which already exist is of prime importance.

How, for instance, are our national political parties to be persuaded to yield control over the thousands of positions which form the very lifeblood of their respective organizations? How are the holders of such positions to become reconciled to giving up their means of livelihood in times like the present when the only alternative to a public job is apt to be a place on the public welfare pay roll? Who is to decide at each level of government which positions are necessary to the performance of essential public services and which are not — which units can be dispensed with and which cannot? And how can we be sure that in streamlining government we are not providing an ideal setup for some future demagogue . . . ?

Republican France owes her highly centralized and efficient governmental system mainly to the dictatorship of Napoleon; will it be necessary for us to pass through a similar experience in order to achieve what are conceded to be desirable ends — desirable at least from the standpoints of organization and administration? Is it not necessary to draw a sharp line of demarcation between the legislative aspects of government — where, in order to avoid the inclusion of sizable minorities, a large number of separate units are to be desired — and the executive functions, where streamlining is advisable? Again, bearing in mind that with each telescoping of adminis- (*Concluded on page 309*)

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RESEARCH . . .

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LET THE distributor's representative who calls on you bring your grinding problems to the Norton Service organization. *See other side.*

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Help You in Two Important Ways . .

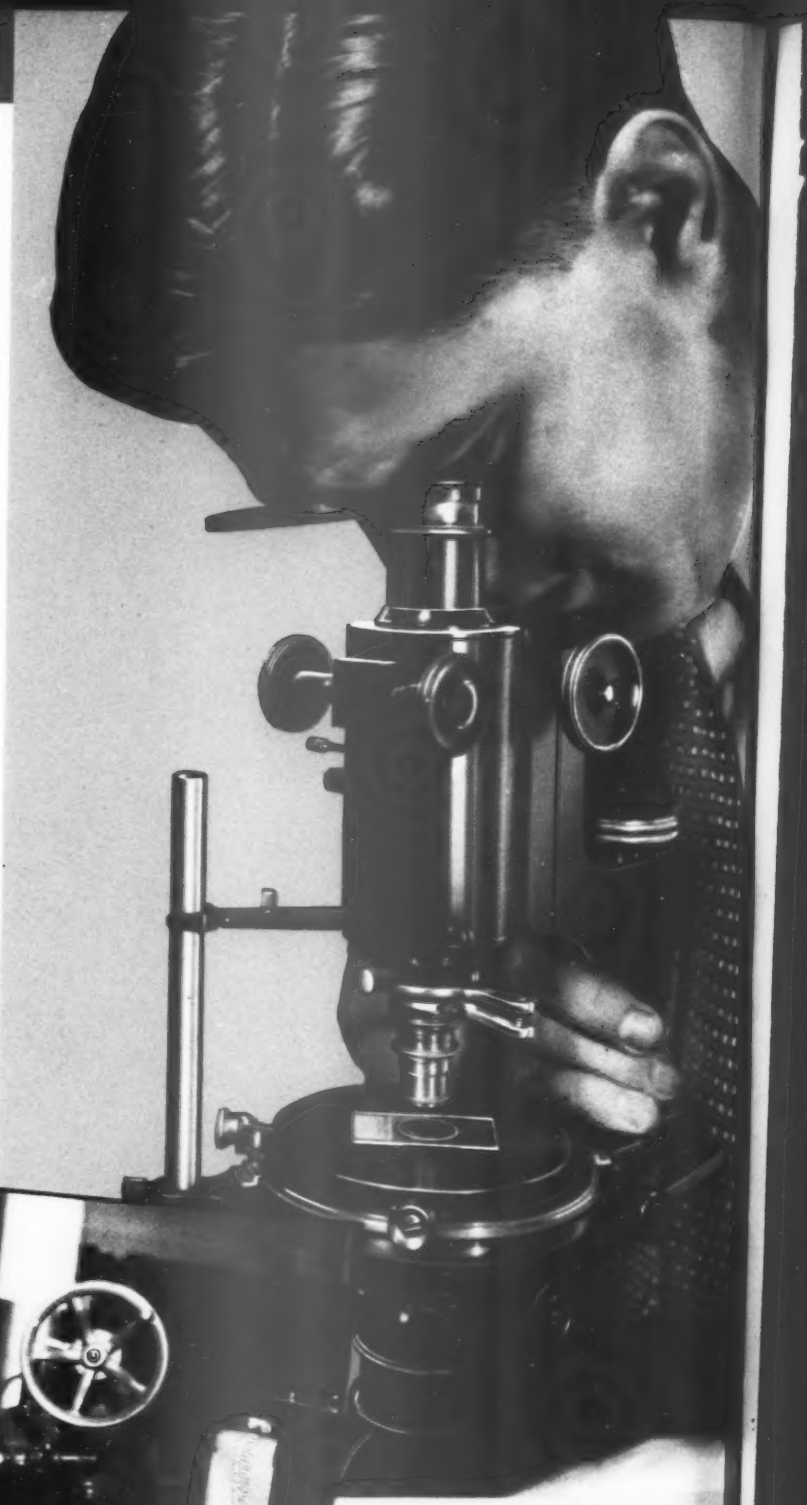
Product Improvement

Many of the fifty trained scientists and technicians in the Norton Laboratories are thinking chiefly of the future — are busy developing new abrasives, new bonds and improved manufacturing processes that you may have better grinding wheels tomorrow. It is their vision and skill that gave the grinding industry B-E bond, controlled structure, diamond wheels, I-R Crystolon abrasive, Norbide (Norton Boron Carbide) and many other outstanding Norton developments.

Product Application

Another part of the laboratory staff specializes on the immediate present — on solving customers' current grinding problems. Practical laboratory engineers cooperate with Norton distributors, representatives and field engineers to determine by actual tests, both in the laboratories and in the customer's plant, the correct wheels and grinding procedure.

You can depend on Norton Service to solve your grinding problems.



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Cleveland Hamilton, Ont.

BEHR-MANNING DIVISION, TROY, N. Y.

4-40

NORTON SERVICE

MAIL RETURNS

(*Concluded from page 308*)

tration the power of some central authority is bound to be enhanced, how are we to maintain those principles of popular control which are the only safeguard against autocracy?

Another point upon which further information would be welcome is the amount of possible savings to taxpayers which would follow a better adjustment of the mechanics of government. Under an authoritarian system, large savings would unquestionably result from a reduction in units, a better adaptation of functions to areas, and the abolition of redundant functions; but under our present dispensation, where every governmental unit and every public job represent vested interests of some sort, how can we be assured that new units or new functions will not, as has so often been true in the past, simply be added to those now existing instead of replacing them?

It is tempting to assume that government is an entity, amenable to the disciplines which prevail in a single corporate organization, but such is far from the fact. Unless we get down to cases and deal with our governments as they are, we do not materially advance the cause of governmental reform. I feel sure that Dr. Rice has considered the practical application of his formulas to specific cases, and I wish that he would follow up his excellent article with an exposition of the means he would employ to insure intelligent action on his proposals.
Boston, Mass.

Of Weights And Measures

FROM WALTER R. INGALLS, '86:

In the last number of The Review [page 269] there is a reference to our systems of weights and measures which is discerning of the reasons why highly organized industrial countries, like Great Britain and the United States, are unable to change to the metric system, whereas such a change in less advanced countries, e.g., Mexico, was not officially very difficult. Of course, it may be pointed out that decimalization is not a unique property of the metric system; there is an increasing tendency to decimalize English weights and measures.

I am writing to you, however, not in a spirit of discussion but rather as a seeker for information. You refer, among other things, to "long and short cords." I am unacquainted with any cord other than 8 by 4 by 4 feet, equal to 128 cubic feet. Will you inform me further? I am conscious of the fact that the height of horses is measured in hands, but I am unaware that the stone as a measure of weight is used anywhere in this country, although in Great Britain the weight of human beings is frequently measured in that way.
New York, N. Y.

[In some cities in the United States, stone is measured by the cord of 100 cubic feet.]

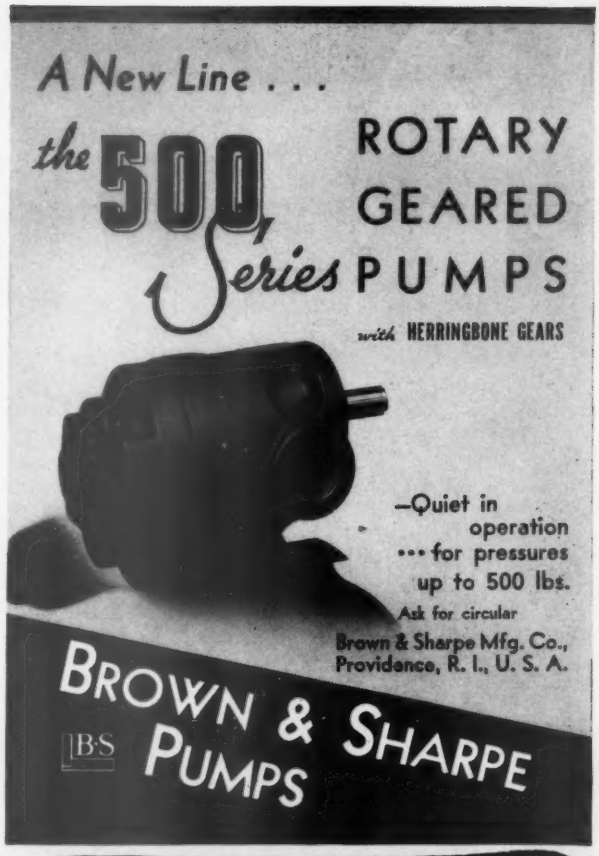
Professor Ware's Advice

FROM LONSDALE GREEN, '87:

The interesting article on page 237 of the April Review, drawn from an early essay by Professor William R. Ware, brings to mind an interesting side light on his career. When I first conceived the idea of going to Technology, I looked around for advice from someone who had been there. Harvey Hannaford, '82, was the man, and I found him quite affable. What he said amounted to this: Before he went to Boston, he had assumed that the success of the architectural course at Technology was due to the fact that Professor Ware was at the head of it. But just before entering Technology, he heard that Ware was going to New York. So he wrote to Professor Ware and asked advice — whether to enter Columbia because Ware was to be there or to go to Boston.

Ware wrote by all means to go to Boston, saying that Letang and other good instructors were there and as far as Columbia was concerned he had yet to build up a staff which might or might not be as competent as the one at M.I.T. Furthermore, in Boston there was a good library, the atmosphere was conducive to scholars of ambition, and so on. Harvey found it so.

I spent only two years at the Institute as a special, but I had had a year in an architect's office. As soon as I returned to Cincinnati, Harvey found me out and took me into the office of Samuel Hannaford and Sons. They had plenty of good work, and soon I got a raise. That was the first time I realized that the reputation of having been to M.I.T. was an asset. . . .
Chicago, Ill.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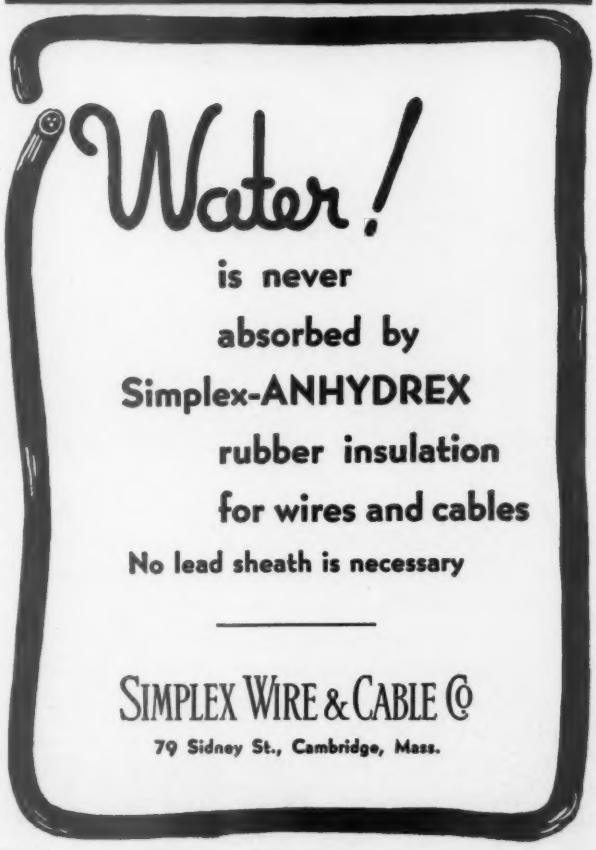

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THE TECHNOLOGY REVIEW

Title Reg. U. S. Pat. Office

EDITED AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

VOL. 42, NO. 8 — CONTENTS — JUNE, 1940

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ON THE MALABAR COAST

From a photograph by Paul M. Wiswall, '09

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Relating to the Massachusetts Institute of Technology

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PUBLISHED MONTHLY FROM NOVEMBER TO JULY INCLUSIVE ON THE TWENTY-SEVENTH OF THE MONTH PRECEDING THE DATE OF ISSUE AT 50 CENTS A COPY. ANNUAL SUBSCRIPTION $3.50; CANADIAN AND FOREIGN SUBSCRIPTION $4.00. PUBLISHED FOR THE ALUMNI ASSOCIATION OF THE M.I.T. FRANK B. JEWETT, PRESIDENT; RAYMOND STEVENS, A. WARREN NORTON, VICE-PRESIDENTS; CHARLES E. LOCKE, SECRETARY; RALPH T. JOPE, TREASURER. PUBLISHED AT THE RUMFORD PRESS, 10 FERRY STREET, CONCORD, N. H. EDITORIAL OFFICE, ROOM 3-219, MASSACHUSETTS INSTITUTE OF TECHNOLOGY, CAMBRIDGE A, MASS. ENTERED AS SECOND-CLASS MAIL MATTER AT THE POST OFFICE AT CONCORD, N. H. COPYRIGHT, 1940, BY THE ALUMNI ASSOCIATION OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY. THREE WEEKS MUST BE ALLOWED TO EFFECT CHANGES OF ADDRESS. BOTH OLD AND NEW ADDRESSES SHOULD BE GIVEN.

Lot's Wife

THE
TECHNOLOGY
REVIEW

Vol. 42, No. 8

June, 1940

The Trend of Affairs

Uranium 235

IN April of last year (page 243), discussing the first experimental and theoretical studies of the explosive division of heavy nuclei, The Review observed that "one can speculate at length on the possibilities suggested by the new discovery, but such speculations are premature as yet." We see no reason to change our opinion at present, notwithstanding recent newspaper declarations of swifter impending revelations.

The only new development is that Alfred O. C. Nier of Minnesota University has managed to separate out enough uranium 235 for John R. Dunning and others at Columbia University to confirm that this isotope of uranium is broken up by slow neutrons, whereas uranium's other isotopes are sensitive only to fast neutrons. Neils Bohr, John A. Wheeler, and others stated last year that this should be true. Last winter several workers computed the amount and concentration of uranium 235 necessary to start a self-continuing reaction when surrounded by water — the water slowing down the neutrons produced by the nuclear explosions so that they can trigger off other explosions. The requisite amounts and concentrations are still not attainable and may not be attainable for many years. This work of Nier and the others brings us a step closer to the practical utilization of nuclear energy, but the step is no greater in size than hundreds of other steps which have been made toward the same goal in the past ten years.

The average scientist viewed the late journalistic furor with amused surprise. In his opinion the time for such articles was last year, when the uranium reaction was first discovered, or else in the future, when enough uranium 235 will have been collected to make the reaction self-sustaining. To us, however, the affair seemed to be a good example of the danger of considering science as spot news. Scientific developments are rapid enough nowadays, but they do not come with the dramatic suddenness characteristic of some other public affairs. An attempt to report science by using the techniques suitable for reporting wars and murders is almost certain to lead to misconceptions. The essential aspect of science is its gradual and co-operative development; and to cry out at some place in its progress that here is *the* big step, this man *the* discoverer, is to falsify the picture and to ignore unfairly the other co-operators.

Most scientific workers dislike this falsification and are, in consequence, cautious when they talk to newsmen. As a result, the reporters complain that the scientists do not co-operate with them and have no imagination. This is, of course, untrue; as a matter of fact, the speculative fancies bandied about among scientific workers when they are by themselves would adequately supply material for several science-wonder magazines. It is only in talking to the reporter that the research worker restrains his fancy; he knows the misunderstandings which can arise when one speculation from hundreds is singled out for the headlines. Perhaps if the reporter wrote a continuing column in which most of the steps in the progress of science could be recorded and in which as many as one out of a dozen of the prevalent speculations could be mentioned, the scientist would not be so cautious. But when one story a field a year makes the headlines, he prefers that story to be factual and sober.

This is, naturally, unfortunate, for scientific news can be just as interesting as murder news, as exciting as political news, and sometimes as important as war news. But it needs its own type of reporting and it needs specialized reporters to cover it — just as do the other fields. There are a few such reporters in this country. More of them would be welcome.

Photos by W. W. Lewis, '89

Toward greater span, more gracile tower, the development of the suspension bridge in America is representatively catalogued in these pictures and those on the next page. Here are, left, *the Brooklyn Bridge, constructed between 1870 and 1883, with a main span of 1,595 feet;* center, *the Camden Bridge at Philadelphia, 1921 to 1926, main span, 1,750 feet;* right, *the Ambassador Bridge at Detroit, 1927 to 1929, main span, 1,850 feet.*

Earthquake Analyzer

SHORTLY before the disastrous Long Beach, Calif., earthquake of March, 1933, the United States Coast and Geodetic Survey installed a number of strong-motion earthquake recorders in the West Coast region. The purpose was to furnish engineers with much-needed reliable data on the nature and intensity of earthquake motions by means of records taken directly in the zone of serious damage, a mission which cannot be fulfilled by the very delicate seismographs used for day-by-day recording of remote earthquakes.

The strong-motion recorder lies dormant until a near-by shock of predetermined intensity trips the trigger mechanism which puts the instrument into action. When the service crew next visit the recorder, a complete picture of the shock is there waiting for them. Some fifty such instruments are maintained by the Coast Survey, and, beginning with the Long Beach quake, many records of large, medium, and small shocks have been obtained already. Fortunately, most of the quakes since 1933 — save those at Helena, Mont. — have been minor. All local shocks have meaning and value to the engineering seismologist; the destructive ones are naturally most important, but even the small shocks are of great value since they occur relatively frequently and yield information that no man-made shaking can give.

To study and compare the extremely complex records of local earthquakes, something far better than visual examination is needed. The engineering seismologist, faced with a growing library of valuable records of destructive and nearly destructive shocks, finds himself at a loss to express their true meaning in a quantitative manner — their power to destroy the works of man.

Arthur C. Ruge, '33, Assistant Professor of Engineering Seismology in the Institute's Department of Civil and Sanitary Engineering, has developed an earthquake analyzer which fills this need in a very practical way by making it possible to plot what might be described as a "destructivity spectrum" of the earthquake in question. The record, in the form of a shadowgraph on a film, is scanned by a light beam falling on a photocell which converts the earthquake record into electrical impulses, just as the sound track on a film is turned into sound. This electrical earthquake is amplified and fed into a galvanometer, the swinging of which represents, to a known scale, the swaying of a building of like vibration period as a result of the actual earthquake. The swinging of the galvanometer is recorded on sensitized paper by means of a light spot reflected from the galvanometer mirror; the maximum swing recorded provides a quantitative measure of the destructivity of the quake to buildings of that particular period of vibration and so gives one point on the destructivity-spectrum curve. Technically, the process would be called wave analysis of a very special type. By means of another photocell and amplifier system, the period and damping of the galvanometer (i.e., the building) can be altered at will within wide limits by simply turning the control dials. In this way the investigator obtains as many points on the spectrum curve as are required for complete definition.

It is expected that the new analyzer will make possible definitive research into the now debated questions of the effects of local

© Gabriel Moulin

The Golden Gate Bridge, built between 1933 and 1937, with a main span of 4,200 feet and two others of 1,125 feet

geological conditions and of large buildings themselves upon the nature and destructivity of earthquake motions, as well as provide a means of classifying and comparing earthquakes quantitatively. In addition, the device offers interesting possibilities in the analysis of other complex functions, such as rainfall data and sunspot activity, since it is able to "spot" the frequencies present regardless of their relative magnitudes; ordinary Fourier analysis can be performed as well. With slight modifications the same machine can be made to solve some extremely difficult and important vibration problems of the mechanical engineer.

This work is done in close collaboration with the United States Coast and Geodetic Survey, as is all of the Institute's research in engineering seismology. The Institute also maintains a seismograph station in East Machias, Maine, interpretation of its records being made by the survey, as part of a strong chain of co-operating stations.

W. W. Lewis, '89

And just by way of contrast: a covered bridge over the Cascapedia River, Gaspé Peninsula, Quebec

Hammurabi and the Hapless Houser

LIKE most other forms of law, the building code has an ancient history. Hammurabi's famous tablets contained many incisions relating to the building industry, of which perhaps the most famous reads: "If a builder has built a house for a man and his work is not strong, and if the house he has built falls in and kills the householder, that builder shall be slain."

Such a law is simple and clear and far easier to understand than a modern building code. In effect, save for the eye-for-an-eye provision, it offers a pattern for some contemporary code reformers who would place everything on a performance basis and make the architect, engineer, and builder vitally responsible for failures. This is a good idea, yet it may seem out of harmony with a current legal philosophy which apparently believes that every man is a scoundrel until proved otherwise.

Our own building codes started out as protection against fire; they were later extended to safeguard minimum health requirements; and still later, to safeguard minimum housing requirements. But while all this was going on, the codes were also warped to safeguard other less desirable things and even developed into legally established boycotts, particularly relating to walls, roofs, electrical work, and plumbing. This venomous trend, together with the wide dissimilarity among the codes of essentially similar areas, has led to strong pressure for reform. Such pressure is not new but, at the moment, it seems stronger than before, and the forces at work seem more harmonious and more likely to attain their objectives.

The inconsistencies are less important than the warping of the purpose of the code. Nonetheless, some of the nonuniformity is ludicrous. Differences of as much as 400 per cent may occur among the cities of New York, Boston, Atlanta, Chicago, and Detroit in allowances for such easily measured things as the cross-grain strength of fir, the strength of specific concrete mortars, the permissible load on identical piles, the required thickness of masonry walls, the amount of concrete required for fireproofing steel or for such readily calculable items as the moment factors for continuous concrete beams in identical circumstances. Plumbing used in the new Department of Justice Building is not, by the codes of many cities, considered good enough for use in houses.

W. W. Lewis, '89

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W. W. Lewis, '89

These representative suspension bridges are the George Washington at New York, constructed between 1927 and 1932, with a main span of 3,500 feet; the San Francisco–Oakland Bay Bridge, opened to traffic in 1936, with two main spans of 2,310 feet; and the Whitestone Bridge at New York, 1937 to 1939, main span, 2,300 feet.

In Denver recently, a school was designed for reinforced-concrete frame construction, and use of curtain walls (nonload-bearing panels) of glazed tile blocks inside, crosstied to terrazzo-faced slabs outside, was proposed. Since the Denver code permits only eight-inch solid masonry for curtain walls, *if masonry be used*, the proposal could not be followed. But quarter-inch plate glass or four-inch glass blocks could have been used in the same curtain-wall areas without code violation.

These silly discrepancies are without malice and have crept in from time to time. By and large, since malice is absent, they can be corrected by constant watchfulness and steady revision. When purpose to protect privilege is behind the law, the situation is different. Such privilege does not quickly relinquish its preferred position. One of the largest manufacturers of plumbing equipment cannot have its wares installed in Chicago. California's law requires 50 square feet free of cabinets in a kitchen; this area is too large for small apartments and effectively prevents the use of strip, or cupboard, kitchens in such apartments. One of the largest prefabricators, utilizing a construction the engineering principles of which were originally developed in the United States Forest Products Laboratory, has had constantly to wage suits against building inspectors who have tried to interpret code provisions too rigidly — often, one suspects, spurred on by local interest which felt itself endangered by the outsider. Typical cases have occurred in Ohio and in Maryland. One of the items of the new Chicago code requires that all interior walls be lined with a fireproof monolithic material. Since the cheapest material is plaster, this prescription is in effect a legal subsidy to the plasterers. This count could be multiplied indefinitely.

There is a more general form of interest which might be said to apply to all existing building craftsmen and, even, to the manufacturers of some conventional building materials. Though these people may, at any given point, be entirely innocent of trying to create a special privilege in the code, they have a joint interest in preventing new methods from reaching the market. Big industry itself has felt the pressure of this sort of thing, which expressed itself merely in a wish to maintain the code in the status quo. Drastically new types of construction have scant opportunity for use except in rural districts or in new towns.

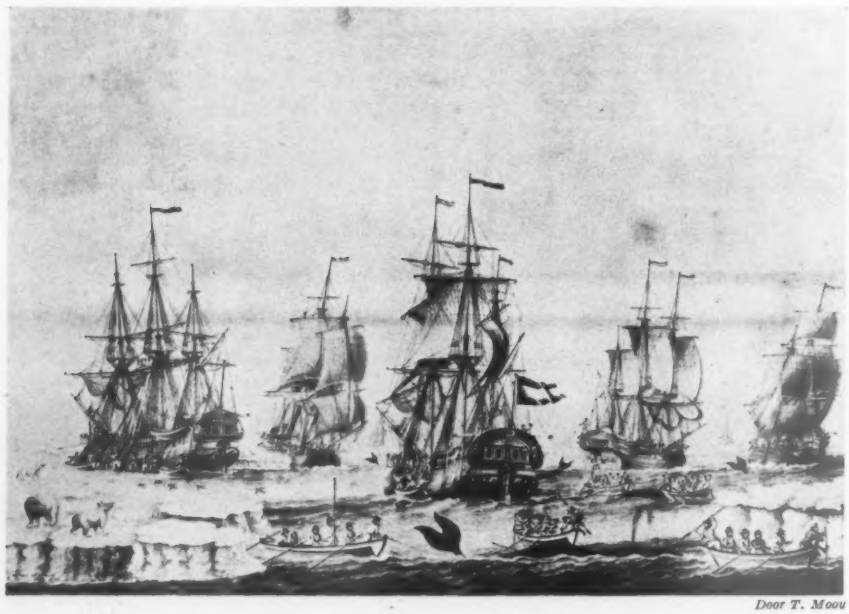
The attack against these practices will take the form of revision of codes on the one hand and of prosecution for restraint of trade on the other. If the various political and sociological auspices are favorable, a substantial basket of chips may be harvested.

Mobbing Moby Dick

WHEN men concentrate on killing each other, the rest of animal creation may expect a new lease on life. Mink in New England streams, for example, are judged to stand less chance of stepping on the pan of a hidden trap as long as the London fur market is upset by war. And at the other extreme among animals hunted for profit, the whale may be given a much needed surcease from the lethal attentions of mankind. German pelagic whaling is in abeyance as a consequence of war, and events in Norway may conceivably have done much to interrupt the operations of the fleets of that greatest of whaling nations. Demand for the products of the whale fisheries, stimulated by the insistence of war, may be frustrated by the same insistence.

If it is so frustrated, mankind should profit in the long run — for leading Norwegian operators are reported convinced that the whaling fishery is certain to become economically unexploitable within the next five years. Whales breed slowly, with but one birth — usually a single birth — in two years; men kill whales more swiftly than ever, so that in spite of international restriction of the catch — including game laws specifiying minimum legal size — the number of whales being killed is four times what the oceans can provide over a long period of years.

Between 1920 and 1940, Robert Cushman Murphy of the American Museum of Natural History reports in *Science*, about half as many whales were killed as during the whole preceding



Door T. Moou

Whaling as it used to be: an unusually fine old water color of a Dutch whaling fleet in the Arctic, one of many rare prints in the Henry P. Kendall whaling collection now on exhibition in the Nautical Museum at the M.I.T. Intent upon atmospheric details, the artist made the three polar bears at the left interested spectators of the whaling chase. Note the crews of the two whaleboats at the right standing with caps lifted high in the cheer of victory as a whale is captured.

history of whaling. For the three centuries ending in 1920, about 3,000 whales were killed yearly; the average annual kill since then has been over 25,000. More than a half million were killed in the seas of the world between 1919 and 1938.

Invention of the Foyn gun in the middle 1860's, the entry of steam catching ships into the Atlantic section of the Antarctic in 1904, the development of the factory ship, which processes the whale carcass in the open ocean and which — served by as many as ten catchers — can handle a dozen whales a day, have combined with demand for food, for food fat and soap material, and for industrial oil thus to decimate the world's greatest animals.

California Department of Public Works

Mechanical ants, tractors busy pioneering a cut and fill down a natural slope of 5:4 during grading operations for a highway cutoff in California

Trail into Turnpike

SNAKE and bat and skunk polecat in parts of the Pennsylvanian mountains during the past year and a half have been undergoing progressive eviction from snug domiciles built for them by men and occupied for over half a century. Started sixty years ago, the route of the South Pennsylvania Railroad between Harrisburg and Pittsburgh drove, through mountain ridges, tunnels that became dark menageries when the project was abandoned after consuming ten million dollars, and the roadbed was left for the forest to reclaim.

Demands imposed by the automobile and the truck led Pennsylvania, in 1937, to constitute the Pennsylvania Turnpike Commission, which, purchasing seven tunnels and 124 miles of roadbed, has raced against time in turning the old trail into a turnpike of great economic and military importance, linking as it does the steel center and the eastern seaboard.

Utilization of the old tunnels, most of which were only about half finished, and construction of 114 bridges and several viaducts make the total amount of climb on the turnpike less than 4,000 feet, as compared with some 13,000 feet on other highways linking the two cities. The tunnels are being bored to greater width and height to accommodate the roadway, which is graded 78 feet wide in the open, narrowing to 28 feet at the tunnel entrances. Two 11½-foot lanes will carry cars within the tunnels, the longest of which burrows 6,650 feet through Sideling Hill.

Federal grants totaling between sixty and seventy millions financed the project. Under the terms of the grants, the highway must be "substantially completed" by the twenty-ninth of this month — hence the race against time, the engaging of 127 contractors and subcontractors, the marshaling of a peak pay roll of 15,000 men plus 1,500 employees of the Turnpike Commission, and the assembling of a spectacular array of the most modern excavating, grading, and road-building equipment. Construction of the turnpike is rated as involving the biggest earth-moving job yet undertaken in road building — the excavation of 26,000,000 cubic yards of earth and rock — the use of 392,000 tons of cement, 50,000 tons of steel, 700,000 tons of sand, and over a million tons of crushed stone. At the end, cars will hum calmly through steel-buttressed, concrete- and glass-lined mountain bores which in their older days were gloomy caverns surrendered to animals.

Skim Milk

ALTHOUGH consumers usually judge the quality of milk by the cream content, many of its very valuable constituents are submerged below the cream line. Because cream always rises to the top, contains fat and vitamin A, and is the source of butter and ice cream, the public has given it a position of importance to which it is not entitled. Whatever may be said about the unattractive appearance of skim milk, it contains the major portion of the protein, calcium, phosphorus, sulphur, and iron content of whole milk, as well as the valuable vitamins B, C, and G.

But skim milk is an outcast, and fifty billion pounds of it are used annually as food for animals and in the manufacture of paints, synthetic resins, textiles, and other commercial products or are simply dumped as waste. Even that portion used for animal food is not efficiently reclaimed, for only about 10 per cent of the food value of skim milk fed to pigs shows up in the pork product.

Thus, in the face of widespread malnutrition, a valuable and inexpensive food is, to a large degree, being wasted. Partially responsible for this condition are the public's natural disdain for skim milk and the widespread ignorance concerning this product's great nutritive qualities. Part of the responsibility rests on certain legislation, originally designed to protect the dairyman, which forbids many combinations of skim milk with other ingredients to make inexpensive but often healthful foods.

Any new foods which can legally help bring skim milk back into the food category are worthy of attention. One such has recently been developed by B. H. Webb of the Dairy Research Laboratories in the United States Department of Agriculture and has been assigned a public patent. The product, which apparently is about ready for production in the form of wafers, sticks, or croutons, consists of skim milk, potato, water, and flavoring. Small and low-grade potatoes may be used, thus suggesting an important new outlet for surplus potatoes.

The new food is made by whipping air into a mixture of skim milk, riced boiled potatoes, and suitable flavoring, drying slowly on a screen at about 185 degrees Fahrenheit as it is extruded through an orifice, and toasting to a light-brown color. The skim milk is essential to the process, since whipped potato alone will dry to a hard, horny substance. Fats and oils destroy the whipping properties.

The plain wafers have a cheeselike flavor which originates in the casein of the skim milk. Some have been coated with commercial cheese to emphasize this flavor. Ground cooked vegetables, including spinach, carrots, and peas, have been added to some batches but without any outstanding addition to the flavor. A member of the Institute's Department of Biology and Public Health has sampled the wafers and feels that their blandness of flavor is probably their only disadvantage. However, there still remains the possibility of using the new food product compounded with other foods.

Two Hundred Million Tons

CHIEF of the secondary metals, scrap iron is the material from which this country makes somewhat more than half its steel. Japan and Italy are forced by inadequate coal and iron-ore reserves to use even higher ratios of scrap to pig iron.

For steelmakers, the great virtue of scrap iron is that it is a by-product which is always available at a price high enough to cover the cost of collecting and transporting it. Conservationists, on the other hand, admire its ability to displace pig iron, every ton of which requires for its making two tons of ore, a ton and a half of coal, and, roughly, half a ton of flux. Scrap is thus the most concentrated form into which the raw materials for steel can be compressed, the logical form for long-distance transportation.

Because Americans are surrounded by more automobiles, skyscrapers, golf clubs, railroads, pots and pans, and similar worldly goods than are any other people, the United States is the world's largest source of scrap iron, the only one with a sizable surplus for export. In the past seven years, the period during which scrap exports have been large enough to attract much attention, this country has produced 210,000,000 tons of scrap. Of these 210,000,000 tons, slightly more than 90 per cent was used within the United States. The remaining 9 per cent went mostly to Japan, Italy, and Great Britain — the last two countries competing neck and neck for a poor second place.

Drying by Freezing

WHEN printers try to speed up their presses, they sooner or later — mostly sooner — discover that the ink isn't being given enough time to dry. Getting ink into such state that the surface of the printed sheet will neither be smudged by, nor smudge, the sheet above it, is done by absorption, evaporation, oxidation, and polymerization. Now freezing is added to the list.

Comes an ink which at room temperature is emphatically a solid. It is delivered to the printer as a block which must be broken and fed to the ink fountain like so much type metal. In the ink-feeding mechanisms of the press, however, it is heated to about two hundred degrees Fahrenheit, at which temperature it has the necessary fluidity for printing.

Since ink is deposited on the paper as a series of dots and thin layers which have more surface than mass, it almost instantaneously assumes the temperature of the room, regardless of its temperature on the press. Hence, the ink solidifies, or "freezes," before it reaches the temperature of the paper — freezes too quickly for penetration into the paper. Regardless of the stock used, the ink remains in relief unless the paper is again heated. Thus penetration can be controlled, eliminating danger of strike-through and the need to make the paper any thicker than is required for strength and opacity.

It is also claimed for the process that cold ink's indifference to capillary action makes possible much sharper impressions on porous stocks, such as newsprint, than would otherwise be possible. Frozen ink wouldn't blot on a blotter.

Good Earth?

LIKE an elderly bookkeeper's metatarsals, the automobile performs most effectively on hard, smooth pavement. At the Iowa State College, a study of rural mail-carrying vehicles shows that gasoline and oil costs go up substantially as the road changes from pavement to earth, and that maintenance costs are even more quickly affected by the nature of the road surface. For the cars used in the test and on a basis of 15,000 miles annually a car, the cost of operation is 36 per cent higher on earth roads than it is on paved roads.

The figure of St. Peter at the Cathedral of St. John the Divine in New York City

R. W. St. Clair, '36

Religion in a Scientific Era

In a Great Realm of Spiritual Values Religion and Not Science Has Its Role

By Karl T. Compton

THE question of the relationship between religion and science is one of perennial vitality, to which both critical and speculative thinkers constantly return. In the light of men's spiritual hopes and material preoccupations, it is natural enough that they should do so; and, since definition and analysis are so exceedingly difficult when they deal with imponderable and sometimes emotional matters, natural enough that agreement on the issue should practically never be reached.

When, as is so often done, the question is put thus: "Is there a conflict between science and religion?" the answer depends upon the claims of the religion. If a religion essays to make pronouncements regarding the materials, laws, and forces of nature — whether laws of physics or astronomy in the inanimate world or laws of biology or heredity in the animate world — then that religion will certainly come sooner or later into conflict with advancing knowledge of science and will certainly be the loser in the conflict. Religious persons of fundamentalist leanings may resent this situation and may lay the blame on the upstart scientists of the last hundred years who have rushed in where angels feared to tread. If any feel thus, I would refer them to a *real* fundamentalist of fifteen centuries ago, St. Augustine, who wrote: "There is some question as to the earth or the sky, or the other elements of this world — respecting which one who is not a Christian has knowledge derived from most certain knowledge or observation: and it is very disgraceful and mischievous, and of all things to be carefully avoided, that a Christian speaking of such matters as being according to the Christian scriptures should be heard by an unbeliever talking such nonsense that the unbeliever, perceiving him to be as wide from the mark as east and west, can hardly restrain himself from laughing."

St. Augustine's admonition, however, has often been ignored. While Benjamin Franklin was making his experiments on the nature of lightning, and his invention of the lightning rod was finding wide and successful use in New England, some of the great clergymen of Boston became highly disturbed over such sinful interference with God's power to strike his wayward children with fear and punishment through thunder and lightning. And when an earthquake shook the region, the pulpit

proclaimed it as God's warning against such interference with his powers. This tacit claim of religion to final judgment on a physical matter certainly reduced the respect held both for the clergymen and for their religion.

Science has not encroached upon the basic functions which religion rightly claims — those having to do with man's aspirations, his ideals, and the motives which guide his emotional adjustment to the world and to his fellow man. Even here science may at times play a role through correction of glandular disorders or psychological maladjustments which so often warp man's outlook on life and lead to antisocial or irrational behavior. But, granting all this, I believe that there is a fundamental religious instinct in man that craves expression, and that there is a great realm of spiritual values and satisfactions in which religion and not science has its role.

With these observations as a background, let me proceed to a few more positive considerations. The sources of such conflicts as have occurred between religion and science are to be found in matters which are really no part of religion. A few centuries ago, for instance, the idea that the earth was not the center of the universe was held to be a deathblow at the Scriptures, for was it not declared that the sun riseth in the East and setteth in the West, and that the stars run through their orbits? The acceptance of our present astronomical concepts was one of the greatest wrenches in the early Christian church, for it was the first of a long series of defeats of the then existent ideas of "infallibility and limitless authority" in which the organized church had clothed herself.

A second wrench came with the acceptance of the earth as round. Navigators even before the time of Columbus knew its shape, though their ideas about its size were inaccurate. But the church fought this knowledge, pinning its faith to the biblical phrase "the four corners of the earth." At one stage in the controversy a queer compromise appeared: Maps of the known world were given a shape like a bulging square, or a circle distorted with four cusps, in order to keep the notion of four corners and yet to give grudging recognition to the knowledge of navigators and astronomers.

In our own day, many churches have been fighting a similarly losing battle against the theory of evolution. Some twenty-five years ago, when my wife was in Young Women's Christian Association work, she visited many colleges where the teaching of evolution was forbidden and even the name was mentioned only in whispers. Groups of girls used to request her to meet them off campus and enlighten them as to the meaning of this forbidden subject. Yet for several generations scientists have seen disclosed in the study of skeletons and fossils an increasingly clear record of evolution in the agelong development of plants, of animals, and, to some extent, of man. But what is more, we are now producing new species of plants and animals in our laboratories, using x-rays or radium or certain chemicals to accelerate processes which have certainly been going on naturally ever since life has existed on this planet. It is even reasonable to expect that this controlled process of evolution may soon be in commercial operation. A number of laboratories have been experimenting with it.

Thus many of such conflicts as have occurred between religion and science hinge on matters which either are the remnants of old superstitions or are accretions which have become attached to religion like barnacles to a ship. Many of these accretions have come through the efforts of religious men to work out a philosophy of life in all its aspects and have become ingrained in church doctrines. But, like barnacles, they have impeded rather than aided religious progress. I believe that science has rendered a great service to essential religion in unshackling it from these incumbrances and thus assisting it in developing more clearly its fundamental objectives.

The impact of science on religion has emphasized the dynamic, as opposed to static, character of religion. An extreme example of static attitude is implicit belief in the literal accuracy and permanent perfection of the scriptures of the Jews or the Bible of the Christians — an attitude which may be illustrated by an incident in my own experience. As is generally known, the age of the earth is estimated at something less than ten thousand years by those who interpret the Old Testament as an infallible historical record of events. Yet by the most accurate measurement of the age of rocks thus far discovered — by their content of radioactive materials and products — scientists hold that they can date the earth in terms of hundreds of millions of years. I once asked a fundamentalist professor in a Christian theological school how he could abide by the literal historical interpretation of the Scriptures as giving the earth an age of less than ten thousand years. He replied: "You scientists make the assumption, which you cannot prove, that the scientific laws which you find true today were also true a thousand or more years ago. I prefer to make the assumption that the Holy Scriptures are absolutely accurate."

Seeing that I could not reach common ground here, I tried the second question: "Which is more important, the virgin birth of Jesus Christ or his teachings, by word and by example, regarding the attitude that men should take toward their fellow men and toward God?" He replied: "The virgin birth is by far the more important because if this be not accepted, we have no basis of authority on which to accept his teachings." I tried to argue that the teachings stood on the authority of their own merit, as proved by experience; and that it would seem strange to me to place the ideals which Christ exemplified, and to which he devoted his life, in a position subordinate to the manner of his birth. But again we could reach no common ground. The width of the gulf represented in this conversation is startling. Extreme case though it is, however, this illustration is typical of the static attitude in religious thinking.

The dynamic attitude is to view the scriptural record as the story of man's continual progress in evolving a religious attitude toward his environment and all that this environment implies. When this point of view is taken, grotesque contradictions disappear. We see the evolution of man's idea of God, from an anthropomorphic conception of numerous deities of capricious behavior and often conflicting purposes, through the notion of a single God who walked and bargained with men — who chastised them and repented — (*Concluded on page 336*)

Cipher for Secrets

Cryptography, First among the Odd Arts Attendant upon War, Is of Long History; Modern Secret Agents May Well Employ Ancient Techniques

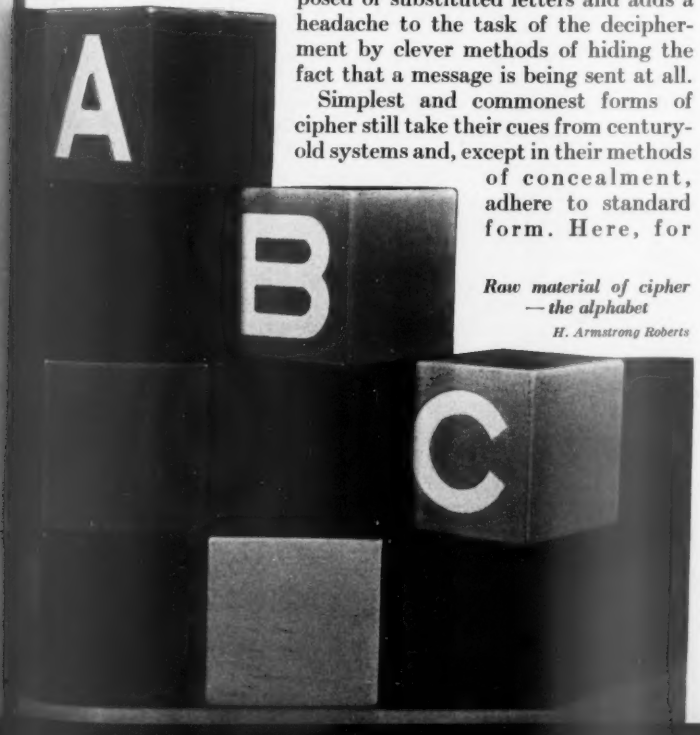
By A. H. Phillips

AMONG the odd arts attendant upon war, cryptography takes first place, for with censors clamping down in all directions and with espionage becoming a major, and very thriving, business, cipher writing steps out of the pages of secret-service fiction into everyday reality. It also, incidentally, steps out of the pages of history, for the art of secret writing goes back into the dim limbo of antiquity: The Greeks, as usual, had a word for it, and Julius Caesar invented a method that, after 1,900 years, still remains a headliner in the cryptographic textbooks.

To meet the cipher menace — and ingenious cryptography was the spy's most vital weapon in the World War — the combatant nations have speedily organized expert deciphering bureaus. The Germans call theirs the Chiffrierbüro; the French, Bureau de Chiffre; and the English, with a schoolboylike taste for the mysterious, Room 40. Routine work to these departments will, of course, be the job of deciphering enemy codes, but the toughest nuts they are called upon to crack are the hundred and one ingenious methods of secret writing, known as cipher, which are at the disposal of the spy fraternity.

Cipher, it is important to remember, differs from code in that cipher is a method of transposition or substitution of letter for letter in a message, whereas each combination used in code represents a definite word or, frequently, a whole sentence. The art of cipher, however, goes farther than mere compilation of a jumble of transposed or substituted letters and adds a headache to the task of the decipherment by clever methods of hiding the fact that a message is being sent at all.

Simplest and commonest forms of cipher still take their cues from century-old systems and, except in their methods of concealment, adhere to standard form. Here, for example, is a typical case history, illustrating a more or less basic use of alphabetical cipher: M3, a confidential shipping clerk with inside information on sailing schedules, is employed as a secret agent by a government interested in all shipping movements. His immediate job is to convey, in writing, to another agent, X4, the sailing time of a ship we shall call the *Ajax*. Since the information has to be conveyed in writing, an alphabetical form of cipher will probably be decided upon. Out of the many means available, the choice will possibly fall on a variation of either the Caesar or the Vigenère system.



Raw material of cipher — the alphabet
H. Armstrong Roberts

The idea behind Caesar's system is the transposition of the letters of a message two, three, or four spaces forward or backward in the alphabet, according to a prearranged key. For example, CROSSING RUBICON TONIGHT, enciphered to a key of four letters backward, becomes YNKOOEJC NQXEYKJ PKJECDP, which, though it no doubt had the Romans guessing, would not fool a modern cryptographer for any longer than it would take him to continue each letter alphabetically, in vertical columns, until the original message became apparent; thus:

Y	N	K	O	O	E	J	C		N	Q	X	E	Y	K	J		P	K	J	E	C	D	P
Z	O	L	P	P	F	K	D		O	R	Y	F	Z	L	K		Q	L	K	F	D	E	Q
A	P	M	Q	Q	G	L	E		P	S	Z	G	A	M	L		R	M	L	G	E	F	R
B	Q	N	R	R	H	M	F		Q	T	A	H	B	N	M		S	N	M	H	F	G	S
C	*R*	*O*	*S*	*S*	*I*	*N*	*G*		*R*	*U*	*B*	*I*	*C*	*O*	*N*		*T*	*O*	*N*	*I*	*G*	*H*	*T*

If M3 and X4 used Caesar's cipher, however, they would probably concoct a cryptographer's nightmare by the use of irregular transposition; working, let us say, to a prearranged key of 4, 8, 2, 3, 6 backward, M3's cipher message with reference to the *Ajax* would read WBYUMWAJPZENCJIJVYV. With the key in your possession, this is easily transposed. First, the message is written with the key over each letter; then the transposition is made according to the number indicated:

	4	8	2	3	6	4	8	2	3	6	4	8	2	3	6	4	8	2	3
	W	B	Y	U	M	W	A	J	P	Z	E	N	C	J	I	J	V	Y	V
1	X	C	Z	V	N	X	B	K	Q	A	F	O	D	K	J	K	W	Z	W
2	Y	D	A	W	O	Y	C	L	R	B	G	P	E	L	K	L	X	A	X
3	Z	E		X	P	Z	D		S	C	H	Q		M	L	M	Y		Y
4	A	F			Q	A	E			D	I	R			M	N	Z		
5		G			R		F			E		S			N		A		
6		H			S		G			F		T			O		B		
7		I					H					U					C		
8		J					I					V					D		
	A	*J*	*A*	*X/S*	*A*	*I*	*L*	*S/F*	*I*	*V*	*E/M*	*O*	*N*	*D*	*A*	*Y*			

PLAIN-TEXT LETTERS

KEY LETTERS

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
B	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a
C	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b
D	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c
E	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d
F	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e
G	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f
H	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g
I	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h
J	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i
K	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j
L	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k
M	m	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l
N	n	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m
O	o	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n
P	p	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
Q	q	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p
R	r	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q
S	s	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r
T	t	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s
U	u	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t
V	v	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u
W	w	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
X	x	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w
Y	y	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x
Z	z	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y

Fig. 1. Resembling a safe, "since it is anybody's property but not worth a hoot unless you have the combination to crack it," this maze of letters is among the aces of all alphabetical cipher systems even today, four and a half centuries after its invention by Blaise de Vigenère, French diplomatist of the Sixteenth Century.

Perhaps the unscrambling looks easy, but get someone to give you an equally simple message, without the key, and you will, *after a few days*, begin to appreciate that searching for a needle in the proverbial haystack is a nursery game compared with the cryptographic hide-and-seek that is still involved in unraveling even so hoary an old-timer as Caesar's cipher.

But we shall presume that M3 and X4 are experts at their game, who realize that however much you complicate the Caesar cipher, it is A-B-C stuff to a trained and clever cryptographer. Moving ahead fifteen centuries, they therefore decide on the Vigenère system, which was invented by a Sixteenth Century French diplomat, Blaise de Vigenère, and remains to this day among the aces of all alphabetical cipher systems.

Basis of this 400-year-old cipher is Fig. 1 (above), which may be said to resemble a safe, since it is anybody's property but not worth a hoot unless you have the combination to crack it. With this table M3 gets busy enciphering his message. First, he cuts it to an understandable minimum — AJAX FIVE MON — and then "keys" it with the word "eight," the reason for which will be apparent later:

AJAX FIVE MON
EIGH TEIG HTE

Now let us follow him as he commences to cipher. The left-hand column of capitals in Fig. 1 represents the letters of the key word, and the top column of capitals, the letters of the plain-text message. The main body of the table represents the eventual cipher letters. The point where the horizontal line from a key letter meets the vertical line from a text letter is the cipher substitute. Thus, the first key letter *E* meets the first text letter *A* at the cipher substitute *e*; the second key letter *I* meets the second text letter *J* at *r*; the third key letter *G* meets the third text letter *A* at *g*; and so on. Try it for yourself, and you will be able to follow M3 as he makes out the following cipher substitutes:

AJAX FIVE MON (Text)
EIGH TEIG HTE (Key)
e r g e ymdk t h r (Cipher)

Even in this short message, you may notice something interesting — that the two *A*'s in the four-letter word "Ajax" are each ciphered by a different substitute and that *e* in the cipher stands for both *A* and *X* in "Ajax." Therein lies a feature that has made the Vigenère cipher an all-time classic in the cryptographic world, for, as you can test for yourself, a plain-text letter in the original message can be represented in the cipher by any one of the twenty-six letters of the alphabet. Thus *A* in a single message can be repeated twenty-six times and every time by a different letter. If a patron saint be sought for the secret agents of the world, his name must undoubtedly be Blaise de Vigenère.

So far, plain sailing, but M3 has now to send the cipher message to X4. He knows that members of the secret service are keeping eagle-eyed tabs on everyone working in the shipping office and particularly on anyone who, like him, has access to any schedules. To send a jumble of unconnected letters, obviously cipher, by mail or telegraph is therefore to court disaster. Of course, he can resort to the use of a secret ink, but this is old-fashioned technique in these days, and M3 knows that between the newly invented vaporizing reagents and ultraviolet photography, the use of invisible inks is likely to prove disastrous. (*Continued on page 336*)

Nutrition and National Health

Dietary Deficiency Is Widespread and Serious, with More Than 40 Per Cent of the Population on Inadequate Rations; Nutritional Defects as Sources of Disease

By Thomas Parran, Jr.

TWO generations ago, the discovery of the bacterial causation of disease opened up a whole new world for medical and health progress. Today, the newer knowledge of nutrition opens up a comparable territory ripe for conquest. The science of nutrition stands now about where the science of bacteriology stood at the turn of the century.

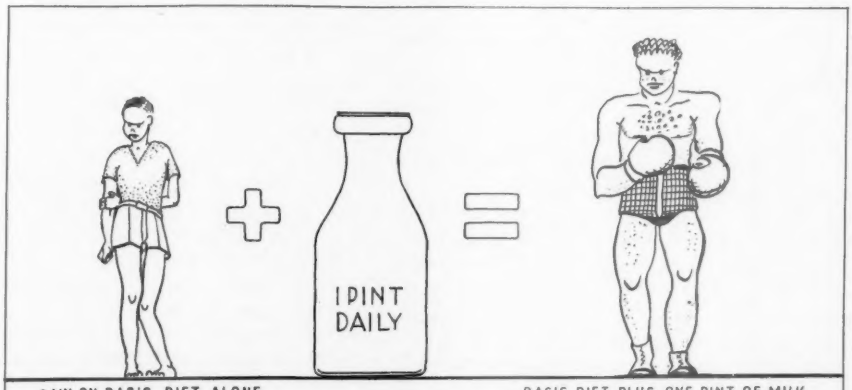
I should like here to discuss the prevalence of malnutrition in the United States; the evidence concerning nutritional status and the major specific deficiencies; the relationship between the state of nutrition and the incidence of acute illness, chronic disease, and the span of life; and the practical steps which seem indicated to promote the national health through application of what we *now* know concerning nutrition.

We have not yet determined the exact nature and extent of the nutrition problem, yet every survey — by whatever method and wherever conducted — has shown that malnutrition is widespread and serious. There is a vast — possibly one to ten — difference between optimum nutrition and frank clinical manifestations of dietary deficiency. More and more emphasis, therefore, must be placed upon optimum and not minimum standards. Our nutritional aim should be existence not merely at a bare margin above the starvation level but at the level which produces abounding health and vitality. Subclinical, or latent, malnutrition is the largest and the most dangerous part of our problem. Like an iceberg, the greater part of it is under the surface.

Of the many causes of unsatisfactory nutrition, the principal but not the only one is faulty diet. The dietary intake is influenced by economic factors — such as the lack of purchasing power for food, and modern methods of manufacture which involve overrefining of foods; and by educational factors — such as poor preparation of food, fixed food habits, poor planning of menus through lack of dietary knowledge; as well as by modifications in nutrition which are due to illness and treatment.

The traditional method for measuring the nutritional status of individuals and of population groups has been through surveys of dietary consumption, comparing foods actually consumed against the best-known standards of what constitutes an adequate diet. Further evidence is available from the effects of supplementary feeding of controlled groups. Records from clinical examinations and physical measurements, particularly of children, also are available. However, both the dietary studies and clinical examinations, including physical measurements, have definite limitations in selecting individuals with nutritional defects. In recent years a number of new laboratory techniques have been developed which give highly accurate information for the detection of the earliest manifestations of specific dietary deficiencies. At present such tests are not available for all deficiencies, but a considerable number of these techniques have been moderately well standardized, and their use in population groups throws much light on many heretofore hidden states of malnutrition.

In recent years numerous surveys of family diets have been made by several governmental agencies. The most comprehensive studies are those of the Department of Agriculture. These show definite correlation between food intake and income level. More than 40 per cent of the people of the country are not getting a diet adequate to maintain good health and vigor. For this portion of the population, diets are poor in respect to specific essential elements, particularly vitamins A, B_1, and C, and calcium. Moreover, the actual amount of food consumed by low-income families is less than that necessary for normal health. The foods of which we, as a nation, have an apparent surplus are those in which the national dietary is deficient — milk and milk products, citrus


1 PINT
DAILY
GAIN ON BASIC DIET ALONE
3.85 POUNDS AND 1.84 INCHES.
BASIC DIET PLUS ONE PINT OF MILK
PER DAY RESULTS IN GAINS OF 6.98
POUNDS AND 2.63 INCHES.

J. Martin Rosse, '40

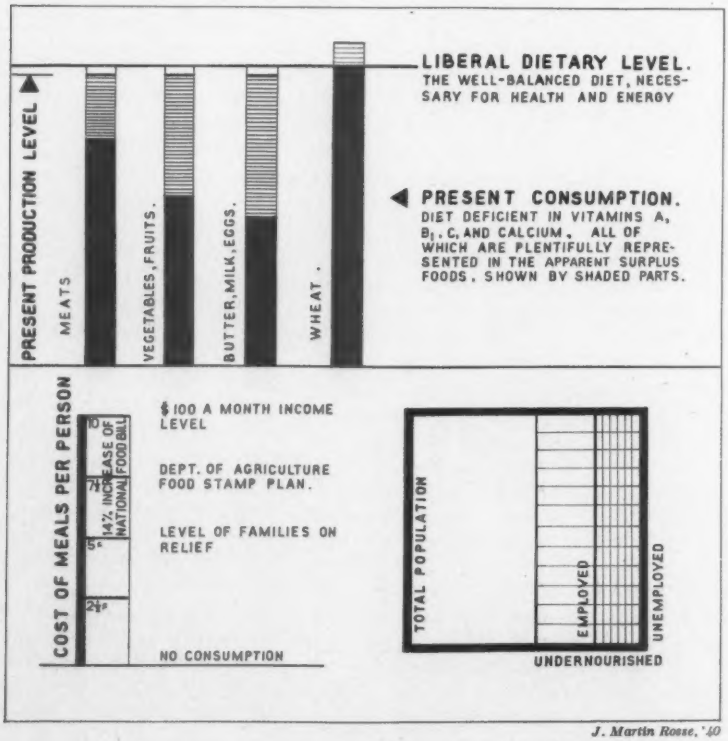
fruits, green vegetables, and meats. It has been estimated that if we were to provide a liberal dietary for our whole population, national food consumption would be increased as follows: vegetables and citrus fruits and others, 50 to 75 per cent; butter, milk, and eggs, 50 to 94 per cent; meats, 10 to 30 per cent. If these levels of food consumption could be reached, there would be not a surplus but an actual deficiency for many products. In fact, it has been estimated that there is no real surplus of food production in this country except in wheat.

Numerous studies of supplementary feeding have, without exception, resulted in improved nutrition, indicating that the previous diet had not been adequate. At least ten such feeding experiments with children have shown remarkable acceleration in the growth and physique of the children as a result of additional food. In 1926 in a school near London, Dr. H. C. Corry Mann made a classic experiment in feeding: Separate groups of boys were fed in different ways, and close records were kept of weight, height, and physical fitness. One group, on a basic diet presumably adequate, gained 3.85 pounds and 1.84 inches. Another group, fed one pint of milk a day, in addition to the basic diet, gained 6.98 pounds and 2.63 inches. "With no deficiency in fresh air or sunshine an immediate improvement in physique followed an alteration in the quality of diet which was adequate from a physiological standpoint." The gains were not temporary but were maintained over a period of years. There was an 81 per cent greater increase in weight and a 42 per cent greater increase in height caused by the added milk. Dr. Mann says: "The casual visitor would never fail to recognize the boys receiving the extra ration of milk; [they were] obviously more fit." In a more recent report, Lydia Roberts has shown that adding an extra pint of milk to the diet of children already receiving a presumably adequate diet, results in increases in height and weight amounting to as much as 20 per cent greater than for those not receiving extra milk. Moreover, many surveys here and abroad show that the height, weight, and vigor of children are less among the poor than among the well to do. Families on relief consume 20 per cent less calories than the minimum necessary for health. Lack of vitamins (especially the B complex) causes a lack of appetite and creates a vicious circle.

From clinical reports, evidence is added concerning the prevalence of deficiency diseases. W. H. Sebrell and V. P. Sydenstricker independently estimate an occurrence of 100,000 cases of pellagra in the South each year. Although regional differences exist, deficiency diseases are not limited to any geographic area. An outbreak of scurvy in Maine was widely publicized a year ago. Studies there made by the Children's Bureau showed that from 30 to 55 per cent of the children — depending upon the season — had abnormally low ascorbic acid levels in the blood plasma, indicating a shortage in vitamin C. A study of the diets of these children showed that probably not more than one child in seven was eating, as often as once a day, any food that is a good source of vitamin C.

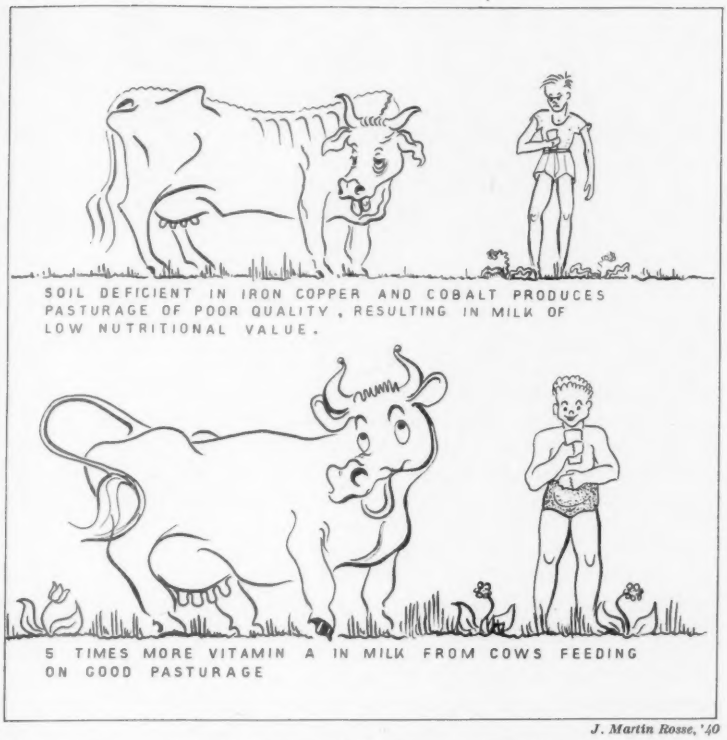
In a children's clinic in Toronto, F. F. Tisdall and E. W. McHenry have reported only 16 per cent of the infants as having a blood ascorbic level believed to be consistent with good health. In the same city, among 400 families having incomes of $10 to $19 a week, the men received only 77 per cent of the needed calories, the women 70 per cent. Measured by accepted standards, these families were consuming one-third the amount of milk, one-half the amount of iron, and two-thirds of the amount of calcium which they needed. In a clinic in Augusta, Ga., Sydenstricker has reported, in 15 per cent of all patients, nutritional edema due to a low intake of protein; and in 35 per cent of all admissions, nutritional anemia due to lack of iron. Through study of high-school children in a poor area of New York City, Public Health Service investigators found a serious shortage of calcium and vitamin B_1 in the diets.

Recent studies indicate that many diseases heretofore not classed as nutritional in origin are in fact due to specific nutritional defects. Almost daily, diseases are added to the list. It has long been known that beriberi is caused by a deficiency of vitamin B_1 (thiamin); that pellagra is due in part to a deficiency in another section of the vitamin B complex, now known to be nicotinic acid; that scurvy is due to a deficiency of vitamin C (ascorbic acid); that rickets is due to a shortage of vitamin D which influences calcium and phosphorus metabolism; and that a lack of vitamin A causes night blindness, xerophthalmia, and a lack of resistance to infection.



J. Martin Rosse, '40

Recent studies by Sebrell have shown that a lack of riboflavin causes a specific skin disease, keratitis. In fact, interstitial keratitis, which is such a frequent complication of congenital syphilis, may be due to a deficiency of riboflavin and may be cured by nutritional methods. E. T. Ceder has shown that the intractable skin disease, psoriasis, is amenable to massive doses of vitamin C. Severe facial neuralgia — the hideously painful *tic douloureux* — is relieved by vitamin B_1 and liver extract. Many symptoms of chronic alcoholism are now known to result from vitamin starvation. Dramatic cures of cases of delirium tremens are reported following the administration of vitamin B_1. A deficiency in magnesium may be a factor in tetany, other cases of neuromuscular irritability, and even convulsions. Cirrhosis of the liver, so often associated with chronic alcoholism, seems to be of dietary origin. Gallstones and stones in the bladder are producible in animals by diets deficient in vitamins and unbalanced in mineral content. Some toxemias of pregnancy are due to lack of protein. Many vague and ill-defined symptoms are relieved by dietary treatment. Arthritis is frequently due to low ascorbic acid and may be relieved by vitamin C.


SOIL DEFICIENT IN IRON COPPER AND COBALT PRODUCES PASTURAGE OF POOR QUALITY, RESULTING IN MILK OF LOW NUTRITIONAL VALUE.
5 TIMES MORE VITAMIN A IN MILK FROM COWS FEEDING ON GOOD PASTURAGE

J. Martin Rosse, '40

The prompt cure of pellagra by nicotinic acid gives dramatic evidence of the influence of a minute amount of a dietary essential, not only upon physical but upon mental illness. In previous years 10 per cent of the patients in mental hospitals in the South were insane because of pellagra. One or two doses of the powerful nicotinic acid or its amide produce prompt cure. Delirium and mania disappear overnight. The patient becomes calm and mentally clear. The severe skin rashes clear up. The red, swollen tongue no longer protrudes from the mouth. In a week or two the bedridden patient feels like going to work.

One might ask why should not the diet of the people in the South be supplemented by regular administrations of nicotinic acid. The drug is useful in treating acute cases, but even though the specific symptoms of pellagra clear up, the patient still is not well nourished. The pellagrin usually suffers from a multiplicity of nutritional disorders. In truth, deficiency diseases rarely are single and specific. This fact is easily understood when one realizes that persons obviously would not choose a diet complete in all except one respect.

Children with pellagra, both in the manifest and less clearly defined forms, are below normal in height and weight. Their progress in school is slow. They are unable to concentrate, have poor appetites, are cross and fretful, and cry easily. The malnutrition of these children frequently starts before birth. Undernourished mothers produce sickly babies and, in the process, drain from their own already depleted bodies calcium, phosphorus, iron, and essential vitamin reserves. These children show a spectacular improvement following a protective food diet, which means milk, green vegetables, fish, and meat. The mother who has an inadequate diet is unable to nurse her baby; dietary deficiency is probably the chief single cause of failure of a mother's milk supply.

Some patients with severe mental disease, showing no clinical signs of pellagra, recover promptly when given nicotinic acid. Dr. H. M. Cleckley recently reported nineteen such stuporous patients. He used the remedy on a hunch. "Response to nicotinic acid was striking. . . . In four cases the vitamin seemed to contribute greatly to improvement; in the rest, 'cure' was dramatic. . . . Nicotinic acid was life saving in practically all of the group and [Cleckley] is equally certain that many persons have been allowed to die because of a failure to recognize the cerebral symptoms of pellagra when other evidences of the disease are absent."

The growth of children is retarded by poor food. As previously stated, many surveys here and abroad show that the height, weight, and vigor of children are less among the poor than among the well to do, and their physical condition is unsatisfactory. Teachers comment almost uniformly upon the noticeable improvement in physical vigor and mental alertness following a mid-morning meal or a well-balanced school lunch. In our educational system we are wasting much money trying to teach children with half-starved bodies and minds. We shall spend tomorrow on the care of their sickness many times over what we save today on food which would prevent it. Moreover, our own people are the greatest potential market for American agriculture. Nutrition is a national, as well as an individual, problem.

From years of debate among doctors as to whether or not a fully adequate diet increases resistance to disease, certain facts are becoming (*Continued on page 344*)

Wild-Life Portraiture

To Show Bird, Beast, or Bug in Satisfying Composition Against a Background at Least Suggesting Habitat Tests Patience and Good Humor, Provides Much Pleasure

By Henry B. Kane

THE night the skunk ran riot in the upstairs bedrooms was a bit trying. It wasn't so much ourselves we were worried about — we could have been buried without much trouble. It was the house itself — it would have taken such a very large hole for the whole house. We discovered some weeks later, though, that we really hadn't known trouble before. That was the morning I awoke to discover that fourteen pine mice had burst their bonds during the night and were well distributed in every nook and boot toe of the house. The fourteenth wasn't found until late evening.

Naturalists as a class are commonly regarded with a bit of eyebrow raising by the saner members of the community. An active interest in the lives and loves of Our Little Friends in Fur and Feathers is not considered quite normal. Photographers, too, are looked upon with a certain skepticism, particularly since the advent of the wild-eyed candid-camera fan and his frequently ludicrous exhibitions of individuality. Put the two together to produce a nature photographer and you've wedded the more insane portions of two much-misunderstood fields of endeavor. I am a nature photographer.

Nature photography sounds like a pretty specialized field, and yet it's really an all-inclusive term descriptive of nothing in particular. It has three main working divisions, related only in the matter of their subject material: First of these is the scientific aspect, which has the sole objective of producing accurate recordings of detail for future study or reference. This branch is self-explanatory and need not concern us further here.

Second is a phase which is achieving increasing popularity — camera hunting. This is the sort of work which George Shiras has done so successfully for years. Any *National Geographic* devotee is familiar with his results. Camera hunting is a logical combination of hunting, with its millions of practitioners, and of photography, with its growing ranks of millions more. There is, of course, a great amount of overlapping, and it is only logical to assume that more and more the camera is supplanting, or at least complementing, the gun as the preferred form of field equipment. It really should have achieved much greater recognition as a form of sport long since. Just think how many things there are to recommend it: no closed seasons, no taboo against standing shots, no bag limit, no stigma attached to small-game hunting — a mouse is as good as a moose. Even jacking is permissible. And when the heat of the chase has cooled, it's much more pleasant to work with D76 than to clean a stiffened carcass, and nowhere near so much dust collects on a framed 11 by 14 as on a many antlered, glassy-eyed head. Probably the main drawback to the popularity of camera hunting is the fact that it's too difficult. A high-powered rifle with a telescope sight will do in a buck at five hundred yards. You couldn't get a recognizable shot of him with a six and a half inch lens at much more than thirty feet. The Nimrod prefers his hunting the easy way.

But I'm really in no position to talk about this hunting aspect. I used to go rabbit hunting with a sealing gun, and with a camera I've rarely stalked anything

Left to right. *White-footed mouse (wild adult): indoors, one No. 16 photoflash and white reflector, f:32 at 1/150; Cooper's hawk (immature): outdoors, "A" filter, sky background, one No. 16 photoflash, f:16 at 1/100; bullfrog: indoors, two No. 2 photofloods, f:32*

All photographs by the author

more sprightly than a turtle. My work has been confined largely to the third and most recent division of nature photography, which I like to call wild-life portraiture. It bears the same relationship to camera hunting that studio portraiture does to candid-camera work in the field of higher mammals.

The object of a wild-life portrait is to show an animal (bird, bug, and so on) against a background at least suggesting his habitat. The attempt is made to secure a satisfying composition, so that even though the viewer doesn't know whether he's looking at a chipmunk or a chickadee he still feels that, as a photograph, the composition is pleasing. This result is rarely, and then only accidentally, achieved in either of the first two classifications. It is the principal aim in the third.

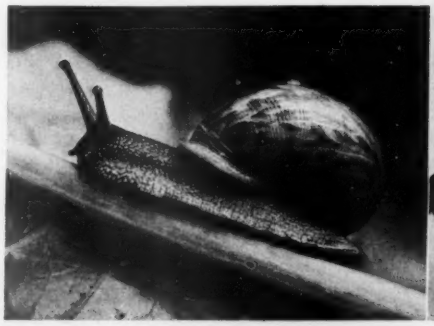
Lady's-slippers: indoors, stump background, two No. 2 photofloods, f:32

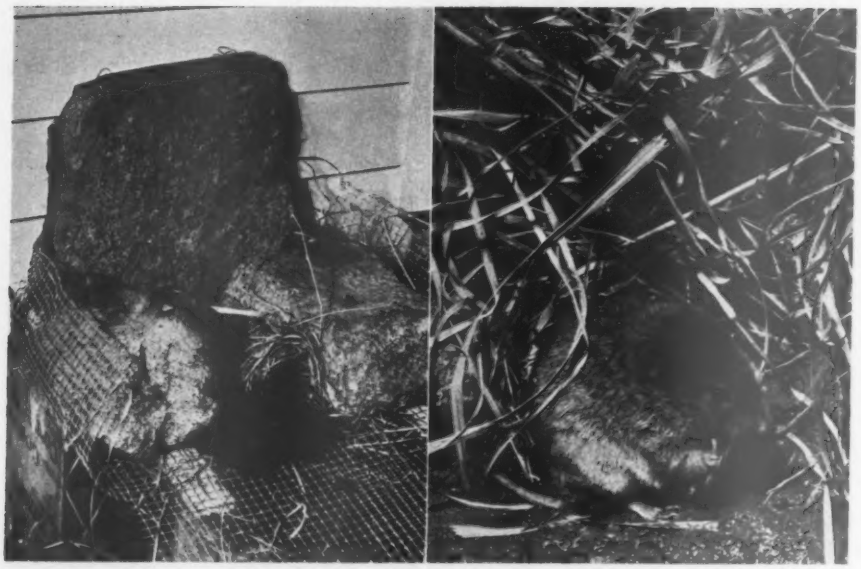
Time was when there were only two kinds of so-called nature photographers: purists and fakers. The purist sometimes went to the ludicrous extreme of branding as fake any picture in which so much as an interfering branch or blade of grass had been removed. Nature hadn't made it that way! I've watched some of these men, through their writings — watched them change their thinking as the years went by and they discovered more imaginative men producing superior results. Today the purist exists only in the realm of scientific recording, his natural field. The term "faker" is reserved for the man who deliberately sets out to misrepresent, attempting to pass off museum shots as the real thing or, sometimes unintentionally to be sure, posing animals in incongruous juxtaposition or surroundings — a kingfisher sitting on a turtle's back, for example, or a mouse sitting on a lichen which is upside down. In between is the entirely legitimate and rapidly growing field of wild-life portraiture. It is this field which we shall explore, on the assumption that many will find it pleasurable.

To begin with, what sort of equipment is needed for this work? Well, let's take a look at the requirements. You'll want to be able to get pretty close to some of the smaller objects, and when you do, you'll need as much depth of focus as possible. A camera with a ground-glass back or a reflex camera is indispensable if you really expect to pay much attention to composition. The size of the negative is open to some debate, but in general the largest size which you consider to be economically justifiable is the best. A good average is 3¼ by 4¼, for sometime you may want to make 11 by 14 prints, and you can't believe all you read in the ads about fine-grain developers and emulsions. There's still a definite loss in clarity with a greater-than-ordinary blowup, and in wild-life photography sharp detail and clean lines are wanted in ninety-nine out of a hundred cases.

These are the principal requirements for the camera itself. One type which meets them is the double-extension, focusing-back camera with a lens speed of *f*:4.5. Mine is a Zeiss Maximar B, and no matter how many cameras I may eventually have, this is one type that will always be indispensable. It has a Zeiss Tessar *f*:4.5 lens and takes a film 9 by 12 centimeters. Eastman, Voigtländer, and several other manufacturers turn out almost identical models. Plates, cut film, or film pack may be used interchangeably. For a number of reasons I prefer cut film. There are also certain "must" accessories, such as a lens shade, sky filters, and a good, sturdy tripod. A dependable exposure meter is practically a necessity, and without a photoflash synchronizer you'll have to forego many a shot. For relatively still-life indoor setups you can use floods, and you'll therefore need some reflectors — two will do for a start.

Left to right. ***Garden snail: indoors, two No. 2 photofloods, f:32; chickadee: outdoors, setup at feeding tray, full winter sunlight, f:16 at 1/200; woodchuck (young): indoors, one No. 16 photoflash, f:32 at 1/200***





Left. *Mailing-tube setup for meadow-mouse pictures, before being covered with grass.* Right. *Meadow mouse, taken at mouth of tube, f:32 at 1/200*

Assuming, then, that you have the equipment and know how to use it, what do you do next? Let's start with one of the easiest live subjects, a frog — preferably a full-grown bullfrog who's too indolent to hop around much. His outstanding features are his eyes, which project an unbelievable distance above his head, and his mouth, with its ear-to-ear grin. The only angle which will show both mouth and eyes to best advantage is a head-on view looking up under the chin to a slight degree. So take a large pan (a dishpan will do), line it with a piece of black cloth to kill underwater reflections, and fill it to the brim. Behind the far end of the pan set a box and on it place a few clumps of marsh grass or ferns. In the water itself set a very few stalks of pickerelweed or arrowhead. Then, on a lily pad held at the surface by some underwater support, set the frog. He'll jump off a few times but will soon realize the futility and resign himself to his fate. Photofloods are easily fast enough for him. Use two No. 2's — one set just above, and at one side of, the camera; the other, on the opposite side about twice as far back. Don't leave them on any longer than necessary, as the heat will soon send the frog in for another bath. Before you shoot, get your eye down as near the lens as possible; you may spot an interfering leaf or twig which is not apparent from above. Stop down all the way, probably to *f*:32. Your lens will be almost at water level — probably no more than 30 to 36 inches away — and you'll therefore need all the depth you can get.

Toads, tree frogs, salamanders, many of the insects can all be taken with no more trouble than this. One extremely important thing to guard against, however, is the error of making the background so confusing that the outlines of the subject itself are lost. In other words, don't let your setup get too "busy," as some photographers like to call it. Two things aid in minimizing this possible pitfall anyhow: The first is the fact that at these short distances the background, if more than six inches or so behind the spot on which you are focused, will be sufficiently out of focus to appear to be in another plane. This condition, incidentally, creates a very welcome third-dimensional effect. The second is the fact that when the subject is so near the light source, intensity drops off fast between foreground and background; as a consequence, the foreground stands out more distinctly than the background.

The use of two light sources introduces one problem which is of relatively minor importance, namely, double highlights in the eyes. They are easily corrected by retouching, but if that is considered objectionable, the second light may be replaced by a white reflector on the shadow side. The main objection to this is the fact that it adds one more prop at the point of action — and when a frog really starts leaving the scene, the clearer the decks are, the easier is his recapture.

Having started with more or less docile subjects, let's turn next to a more active class, animals of a more nervous temperament — mice, squirrels, woodchucks, and so on. Of course if you can find some tame ones or almost matured youngsters, they're easier to handle. Some of the smaller mammals, such as meadow or white-footed mice, can be worked with readily even when taken full grown from the trap, but most adult wild animals are hopeless for this sort of thing. Assuming, then, that you have a fairly tractable subject, let's see how to go about photographing him.

First of all, you'll need to use flash lamps. It's perfectly possible to do successful work without a synchronizer by operating the shutter on "bulb" and flashing the lamp manually, but that procedure is far from satisfactory. A synchronizer is practically essential. Don't fool with a cage. That's one method that has been widely advocated and which can work, but a totally enclosing glass cage imposes so many restrictions that, except in rare circumstances, it's not advisable. The glass through which you must shoot introduces reflections which can be eliminated only with difficulty; the mouse, or whatever you're taking, invariably tries to climb out and covers the cage with footprints; and, more often than not, he wants to lean against it, flattening out his fur on the side near the camera.

The most satisfactory method from the standpoint of results, if not from that of labor saving, is to use a small, totally enclosed room or porch. Except for the necessary equipment, it should be entirely cleared, so that you can chase your model around more readily when he decides to leave the place where you want him to stay, as he will quite often. Make your setup on a small table at camera height. (*Continued on page 348*)

Myth and Metal

Migrations of Peoples and Dispersion of Knowledge Led to the Overwhelming of Bronze by Iron, Which the Mythology of Northwestern Europe Memorializes

By Clark S. Robinson

MYTHOLOGICAL history is good history. But the mythology must be real — that is, must not have been distorted to serve as propaganda — and must be properly interpreted in the light of acknowledged facts. For example, the biblical myth of the Deluge could not be properly interpreted and classified as real history until recent excavations in Mesopotamia uncovered the actual remains of that historic event.

Modern descendants of northwestern European ancestry are fortunate in having both a real mythology uncontaminated by foreign influence, and a tremendous accumulation of acknowledged facts about that ancestry and its prehistoric activity. This material is fascinating — and not merely to those who are inclined toward ancestor worship and who may have been detected in the act of looking up ancestors in the archives of some genealogical society in the hope of qualifying for the Daughters of the American Revolution or the Mayflower Descendants. The period here discussed far antedates 1620, being that portion of the world's history between the years 2000 and 400 B.C., when an extraordinary series of events occurred which influenced our ancestors and us profoundly.

During the first millennium after Christ, emigrants from northwestern Europe, mostly from Scandinavia, settled in Iceland, founding on that remote island a successful and permanent colony. A collection of the mythological folklore of that Norse people, which work we now call the *Elder Edda*, or *Poetic Edda*, or the *Edda of Saemund the Wise*, was made about the year 1100. Approximately one hundred years later, an enthusiast by the name of Sturluson collected additional folklore, which we call the *Younger Edda*, or *Prose Edda*. These two works, protected in that remarkable island from corruption and destruction at the hands of foreign invaders and religious fanatics, constitute a very complete record of the mythology of the ancient Teutonic race. They give one side of the picture of a series of race-shaping events. The other side is supplied by a large group of modern investigators working in the interests of archaeology and of ethnology, who have excavated prehistoric villages, cemeteries, all sorts of spots where our ancestors have left traces of their life and work.

About the year 2000 B.C. the part of Europe in which we are interested was in what is called the Bronze Age, when tools, utensils, and weapons were made not of iron or steel but of that softer, weaker alloy of copper and tin which is called bronze. During this age, the climate of northwestern Europe was mild and fairly dry; the bogs dried up and furnished rich, unforested areas that could be cultivated; the lake levels fell, so that villages could be built on their shores; the forests shrank in size; and agriculture was easy and fruitful. Life in those days was simple and uneventful, a sort of golden age in bronze. In Ireland, that age, when "the vigor of the Irish reached a level never since attained," is called the Heroic Age; among the peoples of Scandinavia and North Germany, the age is recorded thus by the *Elder Edda*, in R. B. Anderson's translation:

> They altars raised
> And temples built;
> Furnaces they established,
> Precious things they forged,
> Their strength they tried
> In many ways
> When making tongs
> And forming tools.
>
> On the green they played
> In joyful mood,
> Nor knew at all
> The want of gold. . . .

H. J. Massingham: Downland Man (Jonathan Cape, Ltd.)

A Bronze Age dagger

Excavations in Drumkelin bog, Donegal County, Ireland, have uncovered a corded oak road and a two-story log cabin which appear to belong to this period. Fourteen feet of bog lie below the cabin floor and 26 above.

During the Bronze Age, iron was a curiosity, a sort of rare and precious metal. It came exclusively from meteorites, the early Greek word for iron being *sideros*, which came to mean "the stars." In the *Iliad* one of the prizes in the races at the funeral of Patroclus was a lump of meteoric iron. Iron objects of that period almost always show, on analysis, from 7 to 11 per cent of nickel, a definite indication of their heaven-sent origin. The common metal of that time, bronze, is a man-made alloy, and it necessitated the bringing together of copper and tin, in alluvial form, from different localities. This requirement stimulated long-distance trade contacts between distant nations, which built up large trading centers and stable agricultural districts. The Bronze Age was a cultured civilization, with peaceable trade both by land and by sea. Investigators working in France on the sites of Bronze Age settlements have recovered over 48,000 bronze axes alone, dating from this period.

But the best of things cannot last forever. Trouble appeared in the East — in Asia Minor: About 2000 B.C. the smelting of iron ore was discovered by the Hittites, a people about whom fifty years ago nothing was known except for biblical references but of whose life and works we now know a great deal, thanks to the efforts of John Garstang. The seat of the Hittite Kingdom was in the central high plateau of Asia Minor around Tuz Göl Lake (known in ancient times as Lake Tatta), in what we now call Anatolia, or Asiatic Turkey. Baked-clay tablets discovered on the site of the capital city have given us our chief information about the Hittites. The special circumstances which were responsible for the development of iron-ore smelting have been investigated by William Gowland and were stated in 1912 in his Huxley Memorial Lecture.

In the first place, the Hittites had two important deposits of iron ore which, exposed by erosion in river valleys, were easy to get at. In the second place, the country at that time was probably well wooded, making the production of the charcoal needed for the smelting a simple matter. The most important circumstance of all, however, was the fact that these Hittites were tall, powerful men of Asiatic descent, who had originally come from the steppe country to the east and not only had the big stone hammers necessary for forging but were strong enough to wield them properly. It appears to have been a case of the right men, the suitable tools, and the needful ore and fuel all brought together at the right time. Excavations have revealed abundant evidence of that metallurgical activity.

Fogg Art Museum

Hittite sculpture — statue of a man and woman from Tell Halaf in Mesopotamia

For many centuries the Hittites held a monopoly in the manufacture of iron, products of their ironworking gradually reaching other parts of the world. Tutankhamen's tomb in Egypt, dated about 1350 B.C., contained many imported iron objects. It appears even that iron weapons occasionally reached as far as northwestern Europe, and the famous blue steel sword used by Sigmund and Sigurd in the *Volsunga Saga* and the *Nibelungenlied* was so superior to the usual softer bronze swords of the period that it was reputed to be able to pierce trees and stone.

The kingdom of the Hittites came suddenly to an end about 1200 B.C. at the hands of the Phrygians, of whom King Midas of gold-hoarding fame is the most notorious. This defeat resulted in a general exodus of the Hittite ironworkers into surrounding countries, into which they introduced their new art. One group of these refugees settled along the seacoast of Judea and became known as the Philistines. It was the superiority of the Philistines' steel weapons which enabled them for so many years to keep at bay the Hebrew tribes who lived in the hill country behind them. The ironworking art also spread gradually westward, and the year 900 B.C. found it well established in the central Danube basin, where valuable deposits of iron ore led to the development of an Iron Age culture. Excavations in A.D. 1846 in an ancient cemetery at Hallstatt, Austria, provided such evidence of this culture that the early Iron Age in that part of Europe is called the Hallstatt period.

The climate then took a part in the drama, and at a date usually fixed at 750 B.C. (a date determined by Werner Lüdi's studies of bog growth in Switzerland and C. E. P. Brooks's studies in Ireland as well as by Ellsworth Huntington's studies of the growth of tree rings) the climate of northwestern Europe suffered an extraordinary and abrupt change. This change is described in the Norse *Elder Edda* as the Fimbul-winter; it was the terrible winter during which, we are told by the ancient singer, snow fell from the four corners of the earth, the frosts were severe, the winds piercing, the weather tempestuous, and the sun imparted no gladness. Three such long and gruesome winters passed, the poet declares, without being tempered by a single summer. As if not enough climatic wrath had been visited upon suffering mankind even then, these were followed by three more similar winters in which, again quoting from R. B. Anderson's translation of the *Elder Edda:*

> Brothers slay brothers;
> Sisters' children
> Shed each other's blood.
> Hard is the world;
> Sensual sin grows huge.
> There are sword-ages, ax-ages;
> Shields are cleft in twain;
> Storm-ages, murder-ages;
> Till the world falls dead,
> And men no longer spare
> Or pity one another.

The heavy rainfall flooded the bogs again, stopping their cultivation; and the lakes rose and destroyed the villages built on their shores.

The peoples of the Bronze Age, who thus had been driven forth from their homes by famine, flood, and cold and by the accompanying anarchy, took refuge in the Central European and East European forests and wildernesses, where shelter from the fierce storms could be had and where life could be supported by hunting. But these bronze-equipped refugees thus came into contact and conflict with the iron-weaponed Hallstatt hordes, at whose hands they perished. In Norse our ancestors called this extermination the Ragnarok; in German, the Götterdämmerung; and in English the Twilight of the Gods. (*Concluded on page 353*)

THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

Alumni Day Nears

Conference and Exhibit Will Make Clear How News and Views Are Gathered and Developed; Banquet Will Honor Dr. Compton

HOW news and views are assembled and sped by various channels throughout the world will be analyzed by able speakers and will be demonstrated in comprehensive exhibits for M.I.T. men and their families and guests on Alumni Day, June 3. After registration from eight-thirty to ten o'clock in the morning, the communications conference on "Channels of World News and Opinion" will be opened in Huntington Hall (formerly Room 10–250) with Frank B. Jewett, '03, President of the Alumni Association and of the Bell Telephone Laboratories, and Vice-President of the American Telephone and Telegraph Company, as presiding officer. President Jewett will introduce as speakers Alfred H. Morton of the National Broadcasting Company, who will discuss "The Role of Radio in World Affairs," and James H. Furay of the United Press Associations, whose subject is "Behind Scenes in the World of News Gathering."

Now Vice-President in charge of television for the National Broadcasting Company, Mr. Morton was European manager for the Radio Corporation of America from 1929 to 1934, served as manager of the program department of the National Broadcasting Company from 1934 to 1937, and came to his present post from that of vice-president in charge of stations managed and operated by N.B.C., which position he had held from 1937 to 1939. He thus will speak of radio in world affairs in the light of broad experience which has dealt greatly with the international phases of radio administration.

A member of the Association of Foreign Press Correspondents, Mr. Furay has had similarly extensive experience in the field of news gathering, with especial acquaintance with foreign affairs. Foreign editor of the United Press Associations from 1918 to 1924, he has been a member of the organization since 1908, was general foreign manager from 1924 to 1937, and since 1937 has been its vice-president. He has thus been himself behind the scenes in the world of news gathering which he will discuss.

Complementing these addresses, extensive exhibits in both the Main and Rogers lobbies will show scientific progress in the transmission of information by wire and radio, offering Alumni an unusual opportunity to learn at first hand the rapid development of the field of communications. The exhibits will include a teletype receiving up-to-the-minute press-association dispatches, a teletypesetter for setting type by wire, a picture transmitter, a ship-to-shore radio transmitter and receiver with radio compass, an aviation radio receiver and transmitter, as well as others. Thus it will be possible to inspect and to see in operation representative devices of the kind essential to the work which the conference speakers are to discuss.

Luncheon in Du Pont Court will open the afternoon's activities, being served at twelve-thirty, and there will be special tables for the classes of 1890 and 1915, this year respectively celebrating their fiftieth and twenty-fifth reunions. Class Day exercises at two o'clock in Lowell Court will find these classes sharing honors with the Senior Class, that of 1940, who will be formally initiated to membership in the Alumni Association during the Class Day ceremonies. The schedule of class reunion programs appears on page 332.

Technology's new swimming pool, made possible by alumni, staff, and student endeavor, will be dedicated at four-fifteen in the afternoon, these ceremonies being the last pre-evening event. At six-thirty, at the Statler,

M.I.T. Photo

A section of Technology's nationally noted dinghy fleet

Class Reunions Summarized

Practically all the classes planning their quinquennial forgatherings have already completed arrangements for their reunions, and, with one exception, these are all scheduled for the week end immediately preceding Alumni Day (Monday, June 3).

1885 — 55th reunion, luncheon tentatively scheduled for June 22, The Country Club, Brookline, Mass.
1890 — 50th reunion, Hotel Marblehead, Marblehead, Mass., June 1 and 2. Special places reserved for luncheon on Alumni Day and at the Class Day exercises in the afternoon. The Class will participate in graduation exercises on June 4.
1895 — 45th reunion, New Ocean House, Swampscott, Mass., June 1 and 2.
1900 — 40th reunion, East Bay Lodge, Osterville, Mass., June 1 and 2.
1905 — 35th reunion, Boxwood Manor, Old Lyme, Conn., May 31, June 1, and June 2.
1910 — 30th reunion, class banquet at University Club, 40 Trinity Place, Boston, May 31; outing at Toy Town Tavern, Winchendon, Mass., June 1 and 2, with special events for the ladies.
1915 — 25th reunion, Oyster Harbors Club, Osterville, Mass., May 31, June 1, and June 2.
1920 — 20th reunion, Sheldon House, Pine Orchard, Conn., May 31, June 1, and June 2.
1925 — 15th reunion, Corinthian Yacht Club, Marblehead, Mass., June 1 and 2.
1930 — 10th reunion, Riversea Inn, Old Saybrook, Conn., June 1 and 2.
1935 — 5th reunion, Mayflower Hotel, Plymouth, Mass., June 1 and 2.

Although they will not be celebrating five-year milestones, the following classes are among those which have scheduled more or less informal get-togethers:

1888 — "Twelfth Webster Class Dinner," 307 Hammond Street, Chestnut Hill, Mass., 5:30 P.M., June 2.
1897 — Colonial Inn, Concord, Mass., June 1 and 2.
1899 — Essex County Club, Manchester, Mass., June 1 and 2.
1904 — Boxwood Manor, Old Lyme, Conn., June 21, 22, and 23.
1907 — Hotel Statler, Boston, Mass., 5:00 P.M., June 3.
1922 — Headquarters, Hotel Kenmore, Boston. Make reservations through C. Y. Chittick, 77 Franklin Street, Boston.

the annual Alumni Day banquet, this year honoring the tenth anniversary of Dr. Compton's inauguration as president of the Institute, will bring Alumni Day 1940 to a brilliant close. Dr. Jewett will be heard again, this time as he sketches the highlights at Technology since Dr. Compton became its president. Dr. Compton himself will make his interesting annual report on the Institute. A demonstration in sound, the "Vocoder," will be presented by its inventor, Homer Dudley.

As in past years, a special program of events for the ladies has been arranged, paralleling that for the men in many respects and including open house in the Forris Jewett Moore Room (Room 6–321) in the Eastman Building from three forty-five to four forty-five in the afternoon; motorboat trips on the Charles at five; and dinner at the home of President and Mrs. Compton, 111 Charles River Road, at six-thirty, with busses to the Hotel Statler for the program following the men's dinner.

President Compton will be host to the Honorary Secretaries, officers of Technology clubs, and Alumni Fund agents at the annual supper at the Engineers Club, 2 Commonwealth Avenue, at six-thirty on the evening of Sunday, June 2. The baccalaureate sermon to the Class of 1940 will be delivered in Walker Memorial at three o'clock that afternoon by James B. Conant, President of Harvard University. Commencement Day, June 4, will see the graduation exercises at eleven o'clock in Symphony Hall, with Henning W. Prentis, Jr., President of the National Association of Manufacturers, as speaker. From two to four o'clock that afternoon the laboratories of the Institute will be open for inspection. The President's reception to the graduates of 1940, their parents, and Alumni in Everett Morss Hall (formerly Main Hall) of Walker Memorial from four to six will conclude the festivities attendant upon the end of another academic year in Technology's history.

Sloan Fellowships

ELEVEN young executives nominated by industries in all parts of the country have been awarded Alfred P. Sloan Foundation fellowships for special one-year programs of advanced study in economics and administration starting at the Institute this month. Two hundred and seventy-nine companies have entered candidates in the annual Sloan fellowship competitions, of which this was the third.

The successful candidates this year are Donald L. Boyes, assistant production manager, Saginaw malleable iron division, General Motors Corporation; Andrew E. Burnett, district engineer, Alabama Power Company; Paul C. Dunn, '34, traveling inspector, Boston and Maine Railroad; William L. Fader, Jr., supervisor, Pittsburgh Forgings Company; Walter D. Howell, industrial power sales division, Pacific Gas and Electric Company; Gaynor H. Langsdorf, '32, superintendent, hydrogenation plant, Standard Oil Company of California; David D. Moffat, Jr., division sales engineer, Utah Power and Light Company; Thomas Waaland, assistant to the director of pasteurizing plants, Sheffield Farms Company, Inc.; Arthur W. Weber, assistant manager, Wellsboro plant, Corning Glass Works; John F. Wilson, supervisor, Hygrade Sylvania Corporation; and George E. Yeomans, Eastman Kodak Company. The members of the group have an average of more than eight years of industrial experience since the completion of their education. Each will receive a stipend of $2,500.

Commenting on the awards, President Compton said: "The economic and social problems of today are numerous and complex, and require for their effective solution the co-operation of industry, labor, and government. To assume its proper share, industry must study intensively our economic and social ailments and the causes underlying them. New and enlarged concepts of the functions and responsibilities of industry are in the making. Old concepts found inadequate by experience are in the process of being discarded. The leaders of business, and all in business, must share in the development of the new ideas or perhaps have less valid concepts forced upon them by those outside industry who may little understand industry's problems. Leaders capable of meeting the new range of problems and deserving of public confidence in ability to share in their solution must be trained to carry on. The young men

to whom these awards have been given have proven ability and demonstrated awareness of the problems to be faced. They seek, through these fellowships, to increase their understanding for the task ahead."

A long list of business leaders, government officials, and representatives of labor will share the responsibility of giving to the Sloan Fellows a fundamental understanding of business and of the responsibility of industry to society. This aspect of the program will be in addition to seminar study, individual investigation, and group visits to industrial plants.

The fellowship program, which is directed by Professor Wyman P. Fiske, is under the general supervision of a distinguished advisory committee composed of Frank Aydelotte, President of Swarthmore College and Secretary of the Rhodes Scholarship Committee; President Compton; the Rev. C. Leslie Glenn, rector of Christ Church, Cambridge; A. Lawrence Lowell, President emeritus of Harvard University; and Edmund C. Mayo, President, Gorham Manufacturing Company.

Council Conclaves

INCREASE of interest and activity among Alumni was remarked upon by President Compton when he told the April meeting of the Alumni Council about his recent visits to western Technology clubs during a trip to the Pacific Coast. His description of the trip and of some of the latest developments at the Institute opened the Council's regular meeting — its 213th — on the last Monday of the month. Presiding was Raymond Stevens, '17, Vice-President of the Alumni Association. After reports from Francis A. Barrett, '24, chairman of Alumni Day; Charles E. Locke, '96, Association Secretary; Arthur L. Townsend, '13, chairman of the Committee on Nominations for Advisory Councils; and Samuel C. Prescott, '94, chairman of the Committee on Annual Awards of Recognition, Mr. Stevens presented as speaker of the evening Edward R. Schwarz, '23, Professor of Textile Technology at the Institute, whose subject was "Textiles in the Light of Modern Science."

Stressing that only after thousands of years of usage has man begun to study the ultimate structure of the important silk, wool, flax, and cotton fibers, Professor Schwarz declared that the important development in textile technology is the realization that physicists, chemists, biologists, botanists, and mathematicians must join in the study of the architecture of natural and synthetic fibers. Between the scientific investigator and the manufacturer stands the textile technologist, whose work may be described as rendering usable and understandable the information coming from the laboratory as he comprehends it in the light of the problems of the textile industry. To function efficiently, he must have the ability to translate the language of science into that of the millman. He must hence be trained, must be continuously supplied with facts by research, and must have a sympathetic hearing by the manufacturer. Professor Schwarz's talk covered many studies that are going on at Technology.

Recent balloting for members of the National Nominating Committee resulted in the election of Charles R. Main, '09, for District 1; Stanley W. Hyde, '17, District 2; Kenneth M. Cunningham, '22, District 4; and Charles P. Fiske, '14, District 5. As class representatives on the Alumni Council, re-elected were William P. Atwood for '76, Godfrey L. Cabot, '81, Arthur G. Robbins, '86, Salmon W. Wilder, '91, John A. Rockwell, '96, Willard W. Dow, '01, Edward B. Rowe, '06, Orville B. Denison, '11, Henry B. Shepard, '16, Henry R. Kurth, '21, Eben B. Haskell, '26, Gilbert M. Roddy, '31, and Robert E. Sawyer, '36. Malcolm G. Wight, '06, newly elected representative for the Technology Club of Hartford, and John F. Ancona, '03, class representative at large on the Council and Honorary Secretary for Rochester, were present at the meeting and were introduced. Elections to Advisory Councils were those of John A. Rockwell, '96, chairman, Athletics; Harold Bugbee, '20, and F. Alexander Magoun, '18, Musical Clubs; Frederick G. Fassett, Jr., staff, and Stanley G. H. Fitch, '00, Undergraduate Publications; and Harry J. Carlson, '92, Walker Memorial.

In the cyclotron laboratory of 1939 Nobel Prize winner Ernest O. Lawrence at the University of California in Berkeley on March 28, shortly before announcement of the Rockefeller Foundation's appropriation of $1,150,000 to assist Professor Lawrence in the construction of a super-cyclotron. After the meeting pictured here, most of the group spent the week end at Del Monte Lodge to discuss cyclotrons and ultrashort-wave radio. In the adjacent photograph are, left to right, Dr. Lawrence; Arthur H. Compton, 1927 Nobel Prizeman and Professor of Physics at the University of Chicago; Vannevar Bush, '16, President of the Carnegie Institution of Washington; James B. Conant, President of Harvard University; Karl T. Compton, President of M.I.T.; and Alfred L. Loomis of the Loomis Laboratories, banker-physicist and life member of the Institute's Corporation.

The 212th meeting of the Alumni Council had been held jointly with the Institute Faculty Club on the last Monday in March. Wat Tyler Cluverius, Rear Admiral, United States Navy, retired, who came to the presidency of Worcester Polytechnic Institute last year, was the speaker of the evening, discussing "A New Experience in Education." Ernest D. Wilson, '14, Frank C. Howard, '17, Kenneth G. Merriam, '22, John P. Vinti, '27, Albert D. King, '32, and John M. Petrie, '32, Institute Alumni now teaching at W. P. I., were guests of the club and Council. Professor Carle R. Hayward, '04, President of the Faculty Club, opened the meeting, subsequently turning its conduct over to Mr. Stevens.

Commenting on contrasts between life in an institution such as W.P.I. and life in the Navy, Admiral Cluverius pointed out that in matters of discipline and ambition, as well as in purpose and incentive, the two are closely related. The training given by engineering schools, he held, is the best adapted to developing men well fitted to enter into world competition; to this training, contributions are made by athletics and fraternity life, as they encourage the mingling of men from various institutions. The gathering together in colleges of students from widely separated parts of the country is similarly valuable, Admiral Cluverius maintained, through its fostering of understanding. Since public relations are coming to be of greater and greater importance in a man's education, anything that schools can do to prepare young men for them deserves encouragement. The problem of W.P.I. and similar schools is how to go on progressively, adjusting their programs to meet changing conditions and new needs as they arise.

M.I.T. Photo

Appropriately enough, the sunny end of this passageway under the wing connecting the Rogers Building and the earlier part of the Institute's main educational plant debouches on the erstwhile entrance familiar to many Alumni as "69."

Credit to the Crews

TECHNOLOGY crews, under new head coach Robert G. Moch, new freshman coach James B. McMillin — both members of the 1936 University of Washington Olympic crew — and veteran Patrick B. Manning, have made remarkable showings this spring. In the first race of the year, the Rowe Memorial Regatta on April 27, all M.I.T. crews — varsity, junior varsity, freshman, and 150 pound — lost very close races to Harvard. In every race except the varsity, Harvard won by less than a full length, and in the varsity race, Technology was defeated by 1¾ lengths and edged by Syracuse by less than a boat deck.

At Princeton, on the following Saturday, all four Technology crews defeated Princeton, losing to Harvard in the varsity and junior varsity races by 1¾ lengths and one length, respectively. At Derby, Conn., on May 11, Technology's freshman crew defeated both Yale and Syracuse. The junior varsity was third in its race, while the varsity defeated Syracuse and was less than three-quarters of a length behind Yale. Not since 1936 have the Harvard and Yale first crews been defeated in sprint races of less than two miles. In view of this fact, the Technology showing can be considered most creditable. Messrs. Moch and McMillin were named to the Institute coaching staff last summer. News writers of the East have acclaimed them and Mr. Manning for the fine showing of the Technology navy.

New Shell Named

IN recognition of his efforts in promoting the use of the Charles River Basin for water sports, the new shell presented to the crew by the Institute Committee has been named for Eugene C. Hultman, '96, chairman of the Metropolitan District Commission of Boston. The christening was performed by President Compton in the presence of Mr. Hultman, members of the Advisory Council on Athletics, the coaches, and members of the various Technology crews, which have made such a fine showing in their races this spring, as the summary immediately above indicates.

Since Mr. Hultman has been chairman of the Metropolitan District Commission, rowing and sailing on the Charles River Basin by public and college groups have been given encouragement. In addition to the activities of the M.I.T. Nautical Association, with its pavilion and fleet of forty dinghies, sailing activities for underprivileged boys of Boston have been organized by community groups, and facilities for both powerboating and sailing have been provided for other groups. Model-yacht sailing, now an international sport, has been encouraged by provision of a special lagoon and a building for storage of the models. In winter these facilities are kept active as well, being used by crowds of skaters.

Graduation Broadcast

ALUMNI will have opportunity to hear the Institute's commencement exercises by either short-wave or long-wave broadcast. Professor Ralph G. Hudson, '07, chairman of the Committee on Commencement, has announced that on June 4, from 11:00 A.M. to 1:00 P.M., eastern daylight-saving time, Station WRUL of the World Wide Broadcasting Foundation in Boston will broadcast the entire program, including the commencement address by Henning W. Prentis, Jr., President of the National Association of Manufacturers, and Dr. Compton's message to the graduates. The broadcast will be on 15.25 megacyles (19.6 meters) and on 11.79 megacycles (25.4 meters). Listeners more than 200 miles from the vicinity of Boston will find the 15.25 megacycle band better for long-distance reception.

Station WMEX, transmitting from Boston on 1,500 kilocycles, will present a regional broadcast of the first hour of the graduation exercises, during which the commencement address will be delivered.

Visiting Committee Reports

TWO more in the series of Visiting Committee reports, abstracts of which appear at intervals in The Review, are presented below.

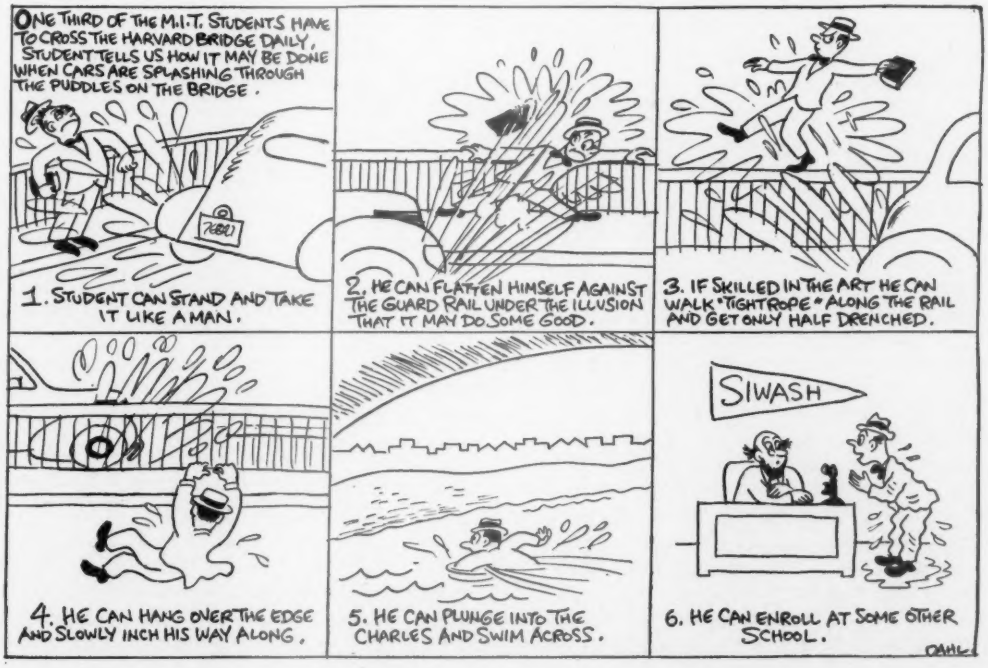
DEPARTMENT OF MECHANICAL ENGINEERING *

AT the Committee's annual meeting, Dr. Hunsaker, '12, reported the expansion of the postgraduate enrollment, which now numbers eighty-three students, exclusive of fourteen special graduate students in Marine Engineering. It is possible to expand the regular number to one hundred. Dr. Hunsaker also reported the new arrangement for honor students, which permits a five-year course with a broader and better-balanced curriculum and with the tuition paid for the last year. This applies to students with records of 4.0 or better. The nine students who have qualified this year constitute about 10 per cent of the Class. If this number should increase, additional scholarships will be needed.

Dr. Compton proposed, and the Committee heartily seconded, an addition to the automotive laboratory. The pressure on the drafting room of the Department of Aeronautical Engineering is becoming so great that the space now used for the automotive drafting room is needed. Meanwhile, the pressure of work in the automotive drafting room itself is increasing, and space in the automotive laboratory is at a premium. These deficiencies could all be met by building an addition to the automotive laboratory, the cost of which would be about $100,000. The lower floor would be devoted to the stock room and to engine storage and display, leaving the laboratory itself free for the installation of additional test engines and an expanding student body. The second floor of the addition would house the automotive engine drafting room, which would thus be immediately adjacent to its laboratory instead of a considerable distance removed from it as at present. The Committee heartily approve of this project, recommend it to the Corporation, and feel hopeful that a donor may be found for the structure.

The Committee further recommend that the Corporation appropriate the sum necessary to purchase a modern precision testing machine for the Testing Materials Laboratory. The one formerly in use for student work is employed on a long-time research. [This appropriation has been voted.] (*Continued on page 353*)

* Members of this Committee for 1939–1940 are Ralph E. Flanders, Chairman, William R. Kales, '92, B. Edwin Hutchinson, '09, John Homan, '15, George J. Mead, '16, Samuel W. Dudley, and R. C. Muir.


ONE THIRD OF THE M.I.T. STUDENTS HAVE TO CROSS THE HARVARD BRIDGE DAILY, STUDENT TELLS US HOW IT MAY BE DONE WHEN CARS ARE SPLASHING THROUGH THE PUDDLES ON THE BRIDGE.
1. STUDENT CAN STAND AND TAKE IT LIKE A MAN.
2. HE CAN FLATTEN HIMSELF AGAINST THE GUARD RAIL UNDER THE ILLUSION THAT IT MAY DO SOME GOOD.
3. IF SKILLED IN THE ART HE CAN WALK "TIGHTROPE" ALONG THE RAIL AND GET ONLY HALF DRENCHED.
4. HE CAN HANG OVER THE EDGE AND SLOWLY INCH HIS WAY ALONG.
5. HE CAN PLUNGE INTO THE CHARLES AND SWIM ACROSS.
SIWASH
6. HE CAN ENROLL AT SOME OTHER SCHOOL.
DAHL

Thus does Francis Dahl, the Boston Herald's *pictorial commentator upon life as she is lived, record a familiar springtime recollection.*

RELIGION IN A SCIENTIFIC ERA

(*Concluded from page 320*)

to the conception of a great spiritual force operating through natural laws which are understandable and dependable and at least partly discoverable through science. We see the picture of a continual development in ideas of right and wrong, from the early notions of obedience to sets of rules to concepts of social justice and human welfare. We see notions of salvation and eternal life becoming less concentrated on selfish considerations and more concerned with service to others and the permanent contribution of our individual lives to the future welfare of mankind. This dynamic concept of religion as a continually evolving and developing spiritual force is inspiring and acceptable in a scientific world. In my judgment the static concept of religion is sterile, discouraging, and unacceptable.

I believe there is justification, and even need, for a variety of religious denominations which emphasize different aspects of that complex thing that we call the spiritual life. There are two reasons for this belief. The first is that there are many different types of persons: Some are emotional, others are severely analytical; some are philosophical, others are active; some like to take initiative and responsibility, others like to be led and directed. So it is natural that there should be churches or other religious organizations where each person can find that type of fellowship and opportunity for expression and activity which will give him the best spiritual satisfaction and development.

A second advantage in having some diversity in religious organizations is that a certain amount of diversity makes for virility and progress. This appears to be true in all aspects of life. It is the diversity of plant life that maintains such life despite diseases and pests which attack and perhaps destroy one or another type. Existence of different types of social organization gives the experience on which sound improvements can be made. In general the tendency for all to herd together makes for safety, conservatism, and stagnation, whereas the tendency for expression of individuality leads to risk and progress, though at the expense of some confusion. I suspect that this truth holds in religion as in other aspects of life. So, on both counts, I do not agree with some who wish that all religions and churches might combine.

A corollary to this last point of view is the need for tolerance and mutual respect between different religious groups. The basis for such tolerance is found in the essential similarity of what I would call the basic objectives and attitudes of all religions. They may differ in emphasis on various points, they may even hold contradictory views on some matters, but all religions worthy of the name possess common ideals of goodness, of unselfishness and service, of reverence for a power which transcends our human strength and understanding. The work of the National Conference of Catholics, Jews, and Protestants is a fine example of enlightened effort to stand together for such essentials.

In recognizing that religion deals with spiritual interests and values, while science is supreme in the field of observable facts and logical relationships, it is proper to remember that, even in the realm of nature, science has its limitations which are not always appreciated. Science never discovered the ultimate origin or purpose of anything. It can find out *how* the universe works, *not* what caused it or what determines the way it works or its *purpose* or its ultimate destiny. If any religion wishes to include a speculation regarding these matters, science cannot gainsay her — for these are outside the realm of science. But, in my judgment, they are also outside the proper realm of religion and, being probably incapable of any proof by observation or deduction, are left only to imaginative speculation.

In conclusion, if I were to try to describe the position of religion in a scientific world, I should summarize the situation about as follows: The entire history of the contact of religion and science shows that the facts of the world and of life which are capable of observation and test, constitute a realm in which science is supreme. Science has not supplanted and cannot supplant or destroy religion in the proper sense. It can, however, give a setting to which our thoughts on religious matters must conform. Science has continually forced men to take an ever wider and grander concept of religion by breaking down artificial barriers of ignorance and superstition. Its whole tendency has been to emphasize the fundamentally spiritual character of religion as representing the highest ideals and aspirations of mankind as opposed to theological rules, doctrines, theories, and so on. Science has therefore had tremendous influence in shifting the emphasis of religion from the physical to the spiritual world, and we must not shut our eyes to the possibility of still further powerful influence of this sort.

Science has thus helped to make religion into a developing, dynamic spiritual force. I believe that the principal influence of science upon religion has been along the following lines: first, to break down "authority" and substitute reason based upon facts of observation; second, to eliminate superstition and chicanery from religion; third, to doom any religion of the static type and emphasize the necessity for a continual development of religious thought to keep pace with and interpret the increasing knowledge regarding all matters which pertain to man's activities and environment.

CIPHER FOR SECRETS

(*Continued from page 322*)

He therefore sits down and writes the following innocent-looking letter to X4:

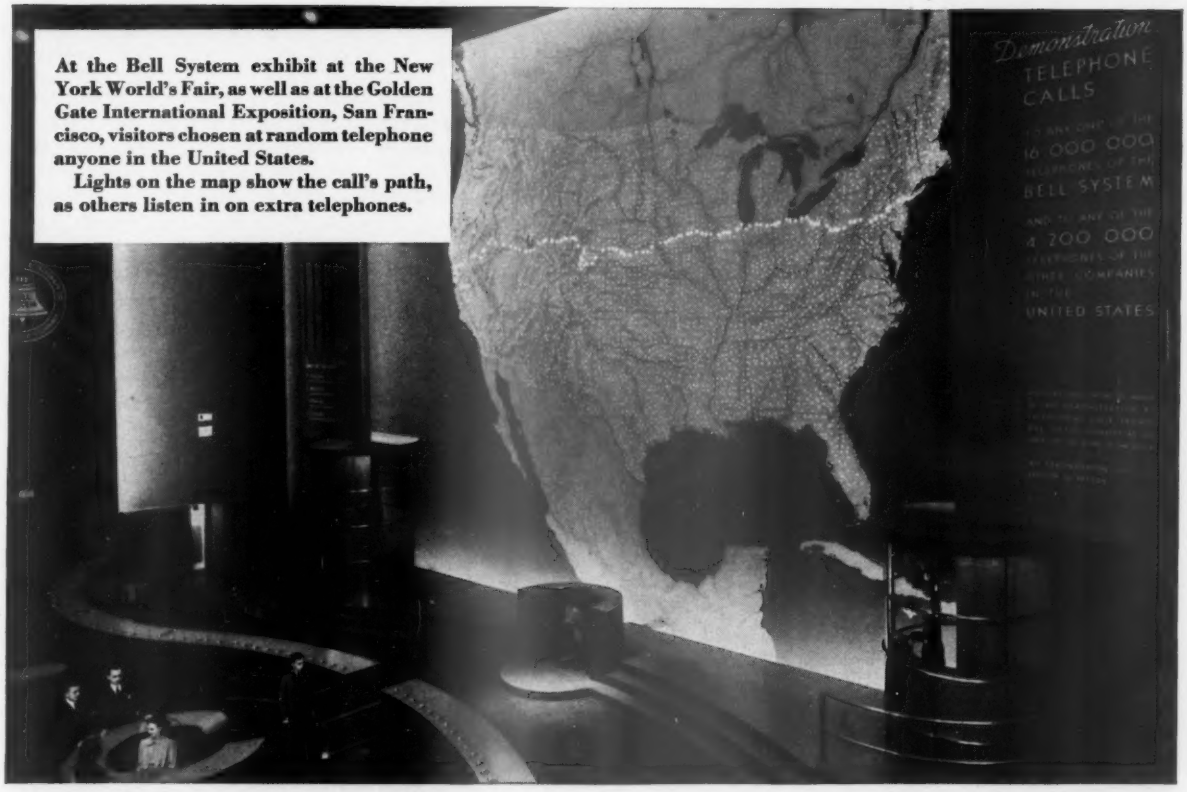
8/8/39

Dear Frank,

Thanks for your letter and enclosed photo which you can surely guess was received with a great deal of pleasure by all of us and especially Ma, to whom it means so much. You certainly have changed in the last few months, but no doubt to Ma you are still the same young kid, mustache or no mustache. Glad to hear that things are moving your way and I hope you will realize hte importance of. . . .

That is as far as X4 reads, for the typing error following the word "realize" tells him that the rest is mere filling.

The date at the top of the letter is the first thing at which X4 looks. It tells him two things: first, that the key word of the cipher is "eight" (*Continued on page 338*)



At the Bell System exhibit at the New York World's Fair, as well as at the Golden Gate International Exposition, San Francisco, visitors chosen at random telephone anyone in the United States.

Lights on the map show the call's path, as others listen in on extra telephones.

Maybe YOUR voice was amplified *a billion, billion, billion times . . .*

The heart of this amplifying system is the vacuum tube, and Western Electric pioneered in making these "Aladdin's lamps of communication." They have made possible long distance telephony, radio and indeed the whole range of modern communication — a striking example of the value to the public of the American way of doing things.

Were you one of the lucky ones? Then the volume of your voice was amplified millions, perhaps billions of times, depending on the distance you talked.

As the diagram shows, the voice fades, and again and again has to be given renewed power in order to reach its destination with all its original clarity and force.

In repeater stations located about every 50 miles, intricate apparatus developed by Bell Telephone Laboratories and produced by Western Electric, performs this wonder—the faithful transmission of speech.

Western Electric ***. . . made your BELL TELEPHONE***

Samson Trade-Mark

Samson Cordage Works

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SAMSON SPOT CORD

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Our extra quality sash cord, distinguished at a glance by our trade-mark, the colored spots. Especially well known as the most durable material for hanging windows, for which use it has been specified by architects for more than forty-five years.

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A. L. Weil '01

CIPHER FOR SECRETS

(*Continued from page 336*)

(for the key is chosen according to the date on which the message was sent) and, second, that the cipher message itself will be disclosed by dividing the wording of the letter into groups of 8, 8, 3, and 9, and then extracting the first letter of each word thus grouped. So, counting eight words from the beginning of the letter, he comes to the word "enclosed" and notes down the letter *e*; eight words from "enclosed" he comes to "received" and writes down the letter *r*; three words from "received" brings him to "great," and he jots down the letter *g*; and so on. Count the message throughout according to this key, and you will be able to write out, as X4 has done, the original cipher message, which, for purposes of decipherment, must be keyed again:

e r g e y m d k t h r
E I G H T E I G H T E

To decipher it, X4 takes each key letter, follows it horizontally along his table until he comes to the corresponding cipher, then moves upward vertically and finds the actual text letter in the top line of capitals. Thus, *E* (key letter) followed horizontally to *e* (cipher letter) discloses *A* as the text letter; *I* (key letter) followed horizontally to *r* (cipher letter) discloses *J* as the text letter. Take an exercise in decipherment for yourself, and you will, or should, check as follows:

e r g e y m d k t h r (Cipher)
E I G H T E I G H T E (Key)
A J A X *F I V E* *M O N* (Text)

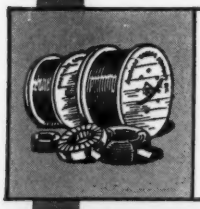
You may wonder why M3 went to all the trouble of ciphering his message when he might have hidden the straight text in a letter, in the same way that he covered the cipher. The answer is that any secret-service operative worth his salt is alert to such an old trick; if the letter had been opened, it would, after being tested for secret inks, have been grouped according to the date, just on the chance of a disclosure.

The beauty of cipher, as compared with its more prosaic relative, code, is its elasticity, and, in consequence, the many methods by which its use may be fitted to circumstantial needs. The secret agent with a single system, however, would be quickly hamstrung; scores of variations on the cipher theme are part and parcel of a competent spy's equipment.

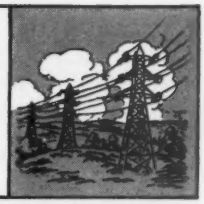
Let us, for example, presume that X4, having received M3's communication, has now to pass it on to another agent, C5, but has strict instructions not to be in direct contact with C5 either by letter, telephone, signal, or even through a third party. One way of tackling the job would be to borrow a leaf from the secret-service archives of the World War and imitate a case which, if it were fiction instead of fact, might have been filed as "The Case of the Man Who Sang in His Bathtub." It happened in Stockholm, where an agent suspected by the Allied secret-service operatives was being shadowed night and day. In spite of the fact that they never let him out of their sight, tapped his phone calls, and opened both his incoming and outgoing mail, not a shred of evidence could they find to (*Continued on page 340*)

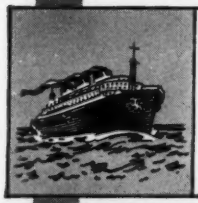
MINE TO MARKET

PHELPS DODGE COPPER PRODUCTS CORPORATION specializes in the manufacture and sale of products made from copper mined by PHELPS DODGE CORPORATION and operates the fabricating units listed below. High quality of product is safeguarded by control of all the stages of manufacture from MINE to MARKET.

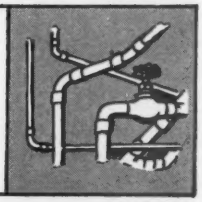


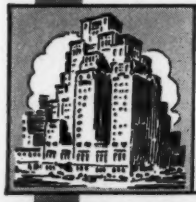
AMERICAN COPPER PRODUCTS DIVISION
manufacturers of copper rods, wire, strip, bus bars, copper ground rods and special shapes, strand, trolley wires, brass and bronze wire and strip, weatherproof wire and P.D.C.P. hollow cables.



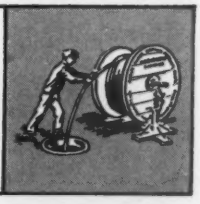


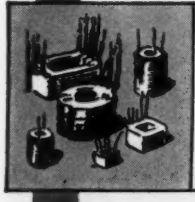
BRITISH AMERICAN TUBE DIVISION
manufacturers of "Bulldog" condenser and heat exchanger tubes, brass, bronze and copper tubes, copper and brass pipe, copper water tubes, oil-burner tubes, brass and bronze rods, and extruded shapes.



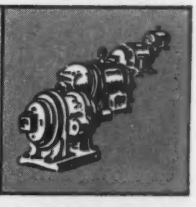


HABIRSHAW CABLE & WIRE DIVISION
manufacturers of paper, varnished cambric and asbestos insulated power cables; oil-filled and pressure cables; telephone, telegraph and signal wires; rubber and lead covered cables; also, Habirshaw "Flame Stop" rubber covered wires and cables.

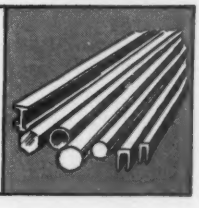




INCA MANUFACTURING DIVISION
manufacturers of enameled copper wire, enameled fabric covered copper wire, single and double cotton or silk covered copper wire, single and double cotton or paper covered rectangular and square copper wire, glass insulated wire and coils.



P-M-G METAL DIVISION
manufacturers of copper alloy products, having special corrosion resistance and high physical qualities; rods, bars, wire, tubing and fittings, strip, sheet, rigid conduit, electric metallic tubing, sand castings, forgings and extruded shapes.



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CIPHER FOR SECRETS

(*Continued from page 338*)

justify any drastic action. All that they could definitely hang on him was an irritating habit of singing vociferously before an open window as he took his morning shower. Even that, however, seemed innocent enough, for his singing was confined to a sort of nondescript gibberish — peculiar, the world over, to bathroom tenors — in which no words were distinguishable. Yet it was this very gibberish that eventually gave him away, but in view of the fact that the method of communication is not easily discerned, X4 might try it as a means of passing his message to C5.

The tune to which the cipher is sung is unimportant, for all that concerns the recipient is the apparent gibberish that is made to serve for words. In these days, with home record-making outfits on the market, the recipient's task could be simplified by recording the voice of the sender, but if direct transcription were made, the singer would probably have to repeat his theme until successful reception was intimated by a request from an apparently annoyed neighbor to "put a sock in it."

Here is what C5 would have on paper when his transcription was completed:

dododaydidododumdeedaydeedododidodeedaydaydee
dodeedidodumdidaydaydumdaydaydodeedidideedodo
daydumdaydumdaydumdaydum

To decipher it, he would first split the transcription into pairs of monosyllables, disregarding the last three as being indicative of the finish of the message:

do do/ day di/ do do/ dum dee/ day dee/ do do/ di do/ dee day/ day dee/ do dee/ di do/ dum di/ day day/ dum day/ day do/ dee di/ di dee/ do do/ day dum

This is now deciphered by a key that, for this message, would run as follows, the left-hand column containing the first monosyllable of the pair, and the top row representing the second:

	dum	dee	do	di	day
day	Y	S	O	J	E
di	H	D	I	C	B
do	P	F	A	K	G
dee	Q	R	W	N	L
dum	T	X	U	V	M

Since this scheme is suitable only to a 25-letter alphabet, a seldom-used letter — in this message, Z — is omitted. Decipherment, as will be seen, is simple, each letter of the original message being found at the point where the appropriate row cuts the appropriate column: thus:

do do/day di/do do/dum dee/day dee/do do/di do/dee day/
A J A X / S A I L
day dee/do dee/di do/dum di/day day/dum day/ day do/dee di/
S / F I V E / M O N
di dee/do do/day dum
D A Y

The actual cipher words are, of course, unimportant and might just as well be ti-tiddle-tee-tum-too or any other combination of five sounds that suit bathroom operatics. This particular (*Concluded on page 342*)

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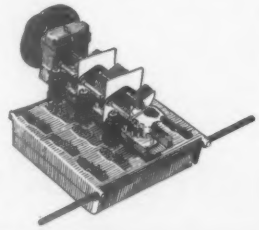

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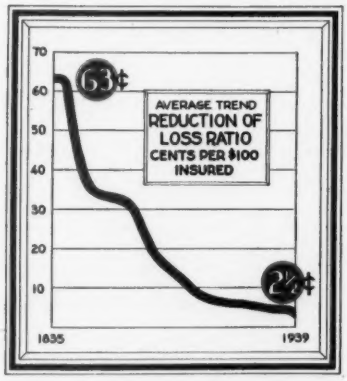
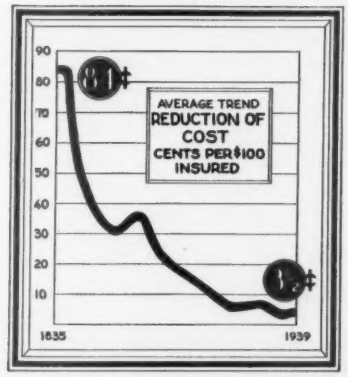


The effect of Fire Prevention and careful underwriting on the Loss Ratio

LOSS PREVENTION IS AN ENGINEER'S JOB



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CIPHER FOR SECRETS

(*Concluded from page 340*)

cipher has many applications and was once used musically, the five key combinations being chords struck by a supposed piano tuner. The ultimate value of a cipher so far as espionage is concerned is adaptability to clever concealment. There is no such thing as an undecipherable system once it has been exposed, but many of the oldest and most easily deciphered methods have, as a result of ingenious disguise, fooled the secret service.

A system that is normally a first lesson in easy cryptography was used successfully during the World War right under the eyes of a small army of Allied secret-service men and did not come to light until years later in a book on Germany's espionage organization. The locale was a small village on the French border of Switzerland, and the villainess of the piece was the proprietress of a small hand laundry, the customers of which lived on both sides of the border. The woman, a Swiss, was in the pay of Germany, and her laundry was a sort of central clearinghouse for information gathered by German agents operating in France. She was, in fact, suspected of passing information, and investigators went so far as to subject the laundry destined for her Swiss customers to tests for secret-ink messages, but with no success. What the secret agents missed was the fact that her excellent service included mending, and that every now and then she would receive from Switzerland a torn shirt which she always returned neatly darned. The darn of the laundered and mended shirt would be carefully unpicked, thus keeping the continuity of the thread unbroken, and along its length would be discovered tiny ink marks. The measured distance between these marks conveyed the contents of her message. She was using the "foot rule" cipher employed by Pierre Berthier, Napoleon's chief of staff.

The sender and recipient of this cipher must each possess a 6½-inch rule measured off in quarter-inch sections, each section representing a letter of the alphabet. The actual arrangement of the letters is unimportant, and we may presume that the laundry proprietress used a rule sectioned off in the manner shown in Fig. 2. To encipher with this rule, you measure the distance from the starting point to the first letter of the message, and from then on, the distance between the last letter ciphered and the next one to be ciphered. In order that the recipient shall know the direction in which the measurements have been made, ten inches are added to those measured from right to left.

Actually, the laundress combined the use of an alphabetical code with this method of cipher. If part of her code message had read XTOPZ, it would have been enciphered in the following measurements: ¾", 1¼", 1½", 10¼", 12¾"; that is,

X = ¾" from the start of the rule,
T = 1¼" from *X*,
O = 1½" from *T*,
P = 10¼" from *O* (¼" plus 10" because the measurement is made backward, or from right to left),
Z = 12¾" from *P* (2¾" plus 10" for right-to-left measurement).

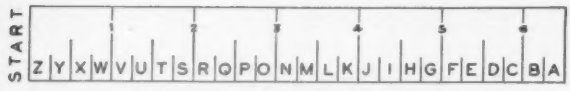

Fig. 2. The 6½-inch ruler, reduced

All she then had to do was to mark these measurements on the thread she used for darning and send the shirts back over the border.

There is among cryptographic teasers a beauty called the "graph" cipher. Here again the actual cipher is open to very easy elucidation, but its value lies in the circumstances under which it can be employed and its purpose effectively hidden. It cropped up in the last war in the guise of temperature charts, barometer readings, and business statistical charts. As events have since proved, it was even used by a presumably reputable scientist working in a Scandinavian country. Figure 3 shows the apparently legitimate sort of electrocardiogram he might have included along with others as part of a paper on, let us say, the effect of calcium chloride on the heartbeats of various animals.

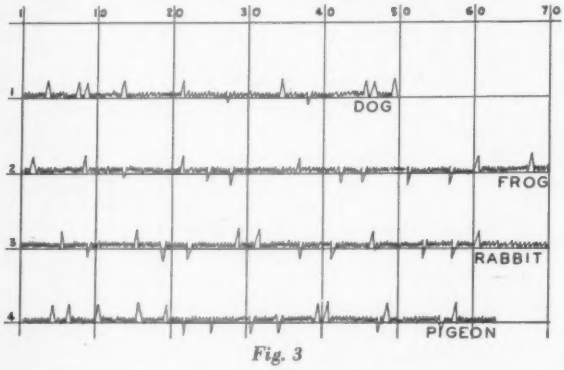

Fig. 3

Immediately on receipt of this cardiogram, the recipient would square it off in tenths of an inch and then number the squares on which each upward stroke of the graph rested, as in Fig. 4.

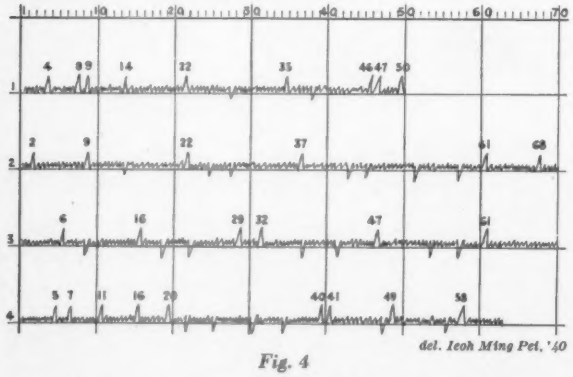

Fig. 4

Thus, the four graphs will be found to read: 4, 8, 9, 14, 22, 35, 46, 47, 50, 2, 9, 22, 37, 61, 68, 6, 16, 29, 32, 47, 61, 5, 7, 11, 16, 20, 40, 41, 49, 58. These numbers are deciphered with the following key:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
20	2	3	21	9	4	11	12	7	10	13	14	17	16	6	25	18	22	5	15	8	1	23	26	24	19
46	28	29	47	35	30	37	38	33	36	39	40	43	42	32	51	44	48	31	41	34	27	49	52	50	45
72	54	55	73	61	56	63	64	59	62	65	66	69	68	58	78	70	74	57	67	60	53	75	78	76	71

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NUTRITION AND NATIONAL HEALTH

(*Continued from page 325*)

clear. From animal experiments the evidence is conclusive that resistance to paratyphoid infections in mice is greatly enhanced by an adequate diet. Further, this effect is shown to be even more pronounced in the second generation.

It has not been possible to confer an immunity to childhood diseases by the feeding of an optimum diet. However, and of more importance, the better-fed children usually recover; those poorly fed die in much larger numbers. Among babies and young children many deaths attributed to pneumonia, measles, whooping cough, dysentery, and other causes probably are due to lowered resistance resulting from malnutrition.

In Upstate New York during the eight years from 1915 through 1922, about 10 per cent of all measles deaths — a total of 203 — occurred in institutions for children. Dr. E. S. Godfrey described the children in these homes as "marasmatic, rachitic, and otherwise undernourished." In eight years, beginning in 1931, only two deaths from measles have occurred in these institutions. The case-fatality rate actually has been lower than in the general population. Better nutrition was not the only factor in the improvement, but as a part of an intensive program to lower infant mortality in these institutions Dr. Godfrey insisted that the diets be supplemented by cod-liver oil (not previously given) and by more milk, fruit, and vegetables.

Animals suffering from deficiency of vitamin A are susceptible to a variety of infections. The loss of resistance appears before other symptoms of vitamin A deficiency, even in animals receiving a diet which is only "nearly adequate." Like nearly fresh fish, a nearly adequate diet is not good enough. Moderate degrees of deficiency of several food factors lower animals' resistance to disease.

Recently, T. D. Spies has reported upon the results of administering Vitamin B_6 to patients who showed symptoms of extreme nervousness, insomnia, irritability, abdominal pain, weakness, and difficulty in walking. "Within four hours . . . all patients experienced dramatic relief of these symptoms, increased strength. Within 24 hours these symptoms had disappeared. One of these persons who had been unable to walk more than a few steps walked two miles within 24 hours after the injection of 50 mg. of Vitamin B_6."

Lack of another part of the vitamin B complex causes graying of the hair in rodents. Suggestions of the possibility of curing baldness and of postponing gray hair in man are not proven. In the vitamin B complex also is a substance the lack of which causes necrosis of the adrenal glands in animals according to recent work at the National Institute of Health.

Vitamin K is necessary for the clotting of blood. A deficiency in this element may cause jaundice. It appears that a considerable number of deaths in infancy due to postnatal intracranial hemorrhages of the newborn result from a deficiency in this substance. A recent report by Wechsler indicates that vitamin E (tocopherol) caused recovery from severe spinal-cord lesions of amyotrophic lateral sclerosis. Moreover, a deficiency in this vitamin causes sterility in animals. At least ten vitamins important to man have been isolated as chemical entities and eight have been made synthetically. Undoubtedly there are still others of which we know not yet.

Every year added knowledge is gathered also concerning the mineral needs of the human body. For life and health at least thirteen minerals seem essential, including calcium, phosphorus, iron, copper, iodine, sodium, cobalt, manganese, magnesium, potassium, chlorine, sulphur, and zinc. Investigations concerning the trace elements are only beginning.

In a recent report O. D. Abbott correlates anemia and stunted mental and physical growth among children, with the kind of soil and with a severe nutritional disease of cattle foraging on certain white and gray sands in Florida. The soils are deficient in iron, copper, cobalt, and possibly other minerals. The addition of these to the diets of both children and animals produced a dramatic change in nutrition. A further relationship between the amount of iron in the soil and that in locally grown vegetables was shown by analysis of turnip greens, which varied from 258 parts per million when grown on productive soils to 56 parts per million when grown on deficient ones. The fertility of the soil influences the food value of the crops grown upon it. Animals feeding on depleted soils produce depleted milk. For example, cows fed on a good grade of alfalfa hay produce milk with five times as much vitamin A in it as do cows fed on a poor grade of timothy hay. Thus, soil conservation has a direct relationship to nutritional status.

There is a very definite interrelationship between minerals and vitamin metabolism. In order for vitamin D, for example, to cure rickets, it is necessary that there be a proper balance between the amounts of calcium and phosphorus in the diet.

The body uses also twenty-two different amino acids, of which eleven must be secured from food, the others being synthesized in the body. These are produced in the digestion of protein and some of them are available only from animal sources. The vitamins, minerals, amino acids, carbohydrates, and fats interact upon each other. A deficiency of one may prevent the body from utilizing other essentials, even though these are available in the diet. The other factors still further complicate the problem. A diet which is adequate during health frequently is not adequate during disease. Various types of infection seem to burn up or prevent the utilization of essential food elements. Certain drugs, also, increase the daily need of the body for certain vitamins. Moreover, there is a direct interrelationship between substances in the diet and the natural secretions of the internal glands of the body in that complicated symphony we call body metabolism, growth, physiology — in short, life. It will thus be seen that forty-odd essential food elements are not merely interesting curiosities of the laboratory but are of concern to all persons, of all ages, in all economic circumstances, and in all geographic areas of the country.

There are definite limits to the preventive and curative effects of education for better nutrition: Economic factors are of basic importance. People on relief spend about five cents a person a meal (*Continued on page 346*)

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NUTRITION AND NATIONAL HEALTH

(*Continued from page 344*)

for food. Families getting incomes of $100 a month spend around ten cents a person a meal for food. The Department of Agriculture has estimated that if all families getting less than $100 a month were able to increase their incomes to that level, there would be an increase of approximately $1,900,000,000 in national food expenditures; the total national food bill would increase 14 per cent. In an effort to improve the diets of families on relief, the Department of Agriculture — through a food-stamp plan — makes possible the increase of food consumption from five cents a meal to seven and a half cents a meal.

When the nutrition problem can be defined more accurately as to size, nature, geographic location, and individuals affected, it can be attacked more effectively. Also, results can then be measured more precisely. Nevertheless, in the United States we *now* know enough about undernutrition to attack it as a national problem. We have the agricultural capacity to provide a good diet for the whole population.

In primitive times through a process of natural selection and survival, the people chose the best available foods. Thus, nations which did not or could not make a wise choice died out. The natural foods contain an adequate amount of the various food elements, but we destroy much of their real nutritional value by cooking and refining. The bolting of flour takes out 80 to 90 per cent of the vitamin B_1 complex and more than one-half of the minerals. Because grain was ground in a primitive fashion, our diets of one hundred years ago were twelve times as rich in vitamin B_1 as are our diets of today. Moreover, we have doubled our per capita consumption of sugar during the past thirty years. Sugar furnishes fuel to the body, nothing else. Since so large a part of the calorie requirements of the body are furnished by sugar and white flour, it is difficult to secure the necessary protective elements. Cooking also destroys some of the vitamins. Vitamin C, for example, does not withstand heat or oxidation. Other vitamins and minerals are leached out in the water used in cooking. While in correcting specific dietary deficiencies it frequently is necessary for vitamins to be prescribed by a physician, the present tendency to buy shotgun vitamin products is largely wasteful. It seems ridiculous that we should take a natural food in which sufficient vitamins and minerals have been placed by nature, refine and remove these constituents, then purchase the same products in concentrated form at an additional price.

It is not easy to define good nutrition. In general, however, a person in a good nutritional state has flesh which is firm, skin which is elastic with a pinkish glow. His mucous membranes are red; his manner is alert; eyes are bright and sparkling; posture is good; his hair is glossy and soft; and there is sufficient fat to round out the body — cover up the angles.

The first step in improved nutrition is to recognize it as a national health problem. It is one which cannot be solved by individuals unaided. In the distant past, progress toward better nutrition was the result of the

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unconscious and instinctive groping of man for a better and more abundant life. What is now required is the conscious direction, on a national scale, of the natural tendency toward better nutrition. In addition to further research that we may know more about the relation of nutrition to health, a nutrition policy must be directed toward two aims — consumption and supply. Where income is adequate, education is effective, but there are definite economic limitations to educational effort. Proper feeding, especially in early life, is a first objective. Provision of supplementary diets through making our surplus agricultural products available to relief families is a valuable contribution. There should be a greatly increased milk consumption by children and expectant and nursing mothers. The provision of school meals would do much to increase the amount and improve the quality of children's diets.

Through governmental action, agriculture can be adapted better to the nutritional needs of the nation. Since agriculture has become an "assisted industry," it is not unreasonable that the government should direct this assistance so as to insure the production of materials essential to national welfare. The ways and means of accomplishing this seem quite feasible and follow naturally from the current measures for soil conservation. Home gardens, canning and preservation of food, encouragement of dairying in the cotton, wheat, and mechanized agricultural areas are important.

Freight rates are important factors in the final cost of many food products, especially the green vegetables and citrus fruits. Through lowered (*Concluded on page 348*)

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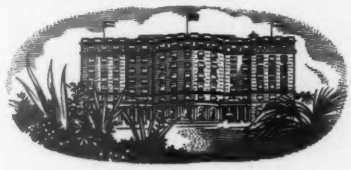

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Reserve for Losses Unreported	199,500	Cash	199,500
Reserve for Federal Taxes	80,000	Cash	80,000
Reserve for Dividends	270,000	Cash	270,000
		Cash	317,140
Unearned Premium Reserve	4,615,817	U. S. Government Bonds	4,175,125
		State, County and Municipal Bonds	123,552
All Other Reserves and Liabilities	1,487,862	State, County and Municipal Bonds, Railroad and Public Utility Bonds	1,487,862
		Public Utility and Corporation Bonds	430,680
Capital $3,000,000		Canadian Government, Provincial and Municipal Bonds	106,831
Surplus 14,650,936		Stocks	6,995,643
Policyholders' Surplus	17,650,936	Old Colony Insurance Company	8,112,678
		Real Estate (Home Office Building)	975,000
		Premiums in Course of Collection and Other Admitted Assets	1,030,104
	$25,098,071		$25,098,071

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NUTRITION AND NATIONAL HEALTH

(*Concluded from page 347*)

freight rates, wider distribution of these products would be encouraged. Tariff policies also have a direct influence on food costs and, therefore, on food consumption and should be made with a view to improved national nutrition. Refrigeration and storage facilities, lower distribution costs, quick and adequate transportation — all are measures for better nutrition.

In a publication of the International Labour Office, it is pointed out that "there is also growing support for the proposal that State provision for the adequate nutrition of special groups of the population such as infants, school children, expectant and nursing mothers, upon whose well-being the future of society depends, should be treated as a social obligation akin to that of popular education."

In a problem as complicated as that of national nutrition the solutions similarly are complicated but not impossible. All authorities point to the crucial importance of adequate nutrition for certain population groups. One good meal a day for every school child would save, not burden, educational budgets. For expectant and nursing mothers, for babies, and for many diseased patients, food is medicine. For those unable to provide for themselves proper food in adequate amounts, the community should accept responsibility in the way it now accepts responsibility for seeing that no one starves. My proposal is simply that we should allow no one to starve, but I point out that science has given us a new definition of starvation. If a person actually starves to death, the community is at least relieved from the burden of supporting him in sickness and disability through long years. In the new concept, starvation may be even worse in its ultimate social effects than were the ancient famines which periodically killed off a large part of the population.

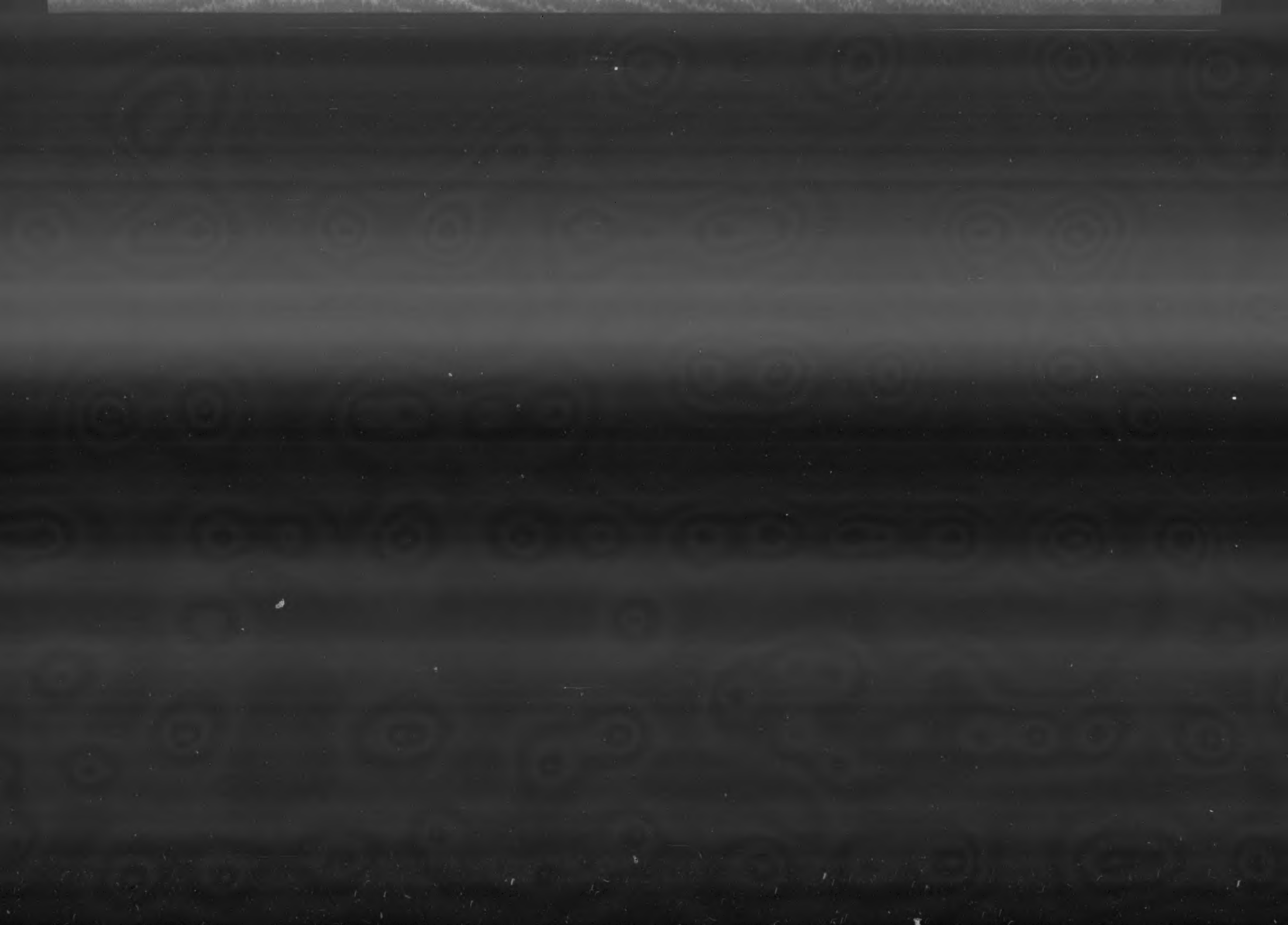
Month by month in dozens of research centers, evidence is accumulating as to the influence of diet and nutrition upon the physical and mental status of the race. Dr. H. C. Sherman has stated, and I agree, that experience to date indicates that we can defer senility and increase by seven years the average *virile* span of life. This would mean more in terms of longevity than to wipe out cancer as a cause of death. Through adequate nutrition we have it in our power to build a new race of people in America.

WILD-LIFE PORTRAITURE

(*Continued from page 328*)

Fix the reflector above, and at one side of, the camera. Never use a flash lamp mounted on the camera itself, as the flat lighting that will result is most objectionable. Two lamps may be used, but the use of a reflector instead of one of the lamps would save expense. If available, a white wall will do very well. Focus on some point which will remain in position no matter how much the mouse runs about, and then you're ready to start.

A typical solution to a problem of this sort will serve to illustrate the procedure: I was making a series of pictures of native (*Continued on page 349*)



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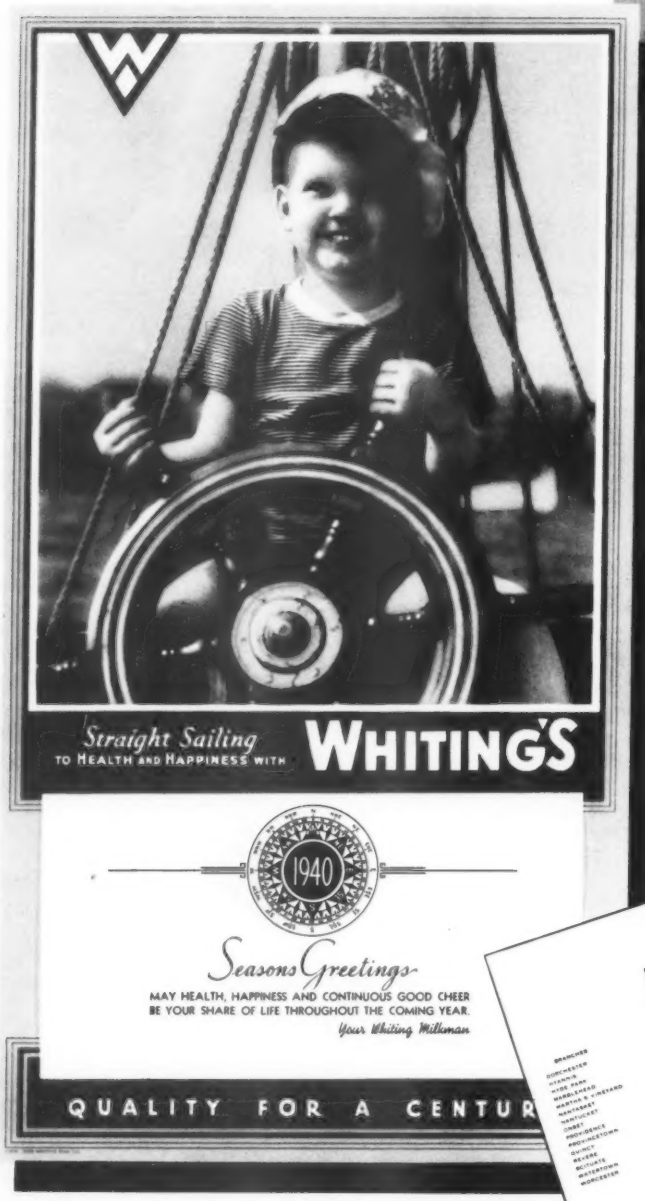

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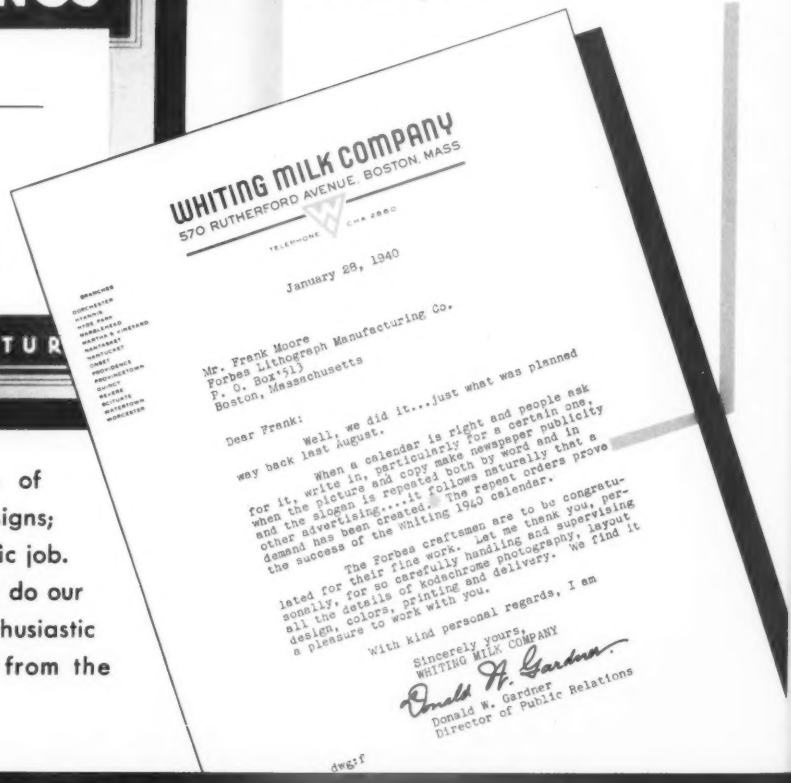

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Donald W. Gardner
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dwgjf

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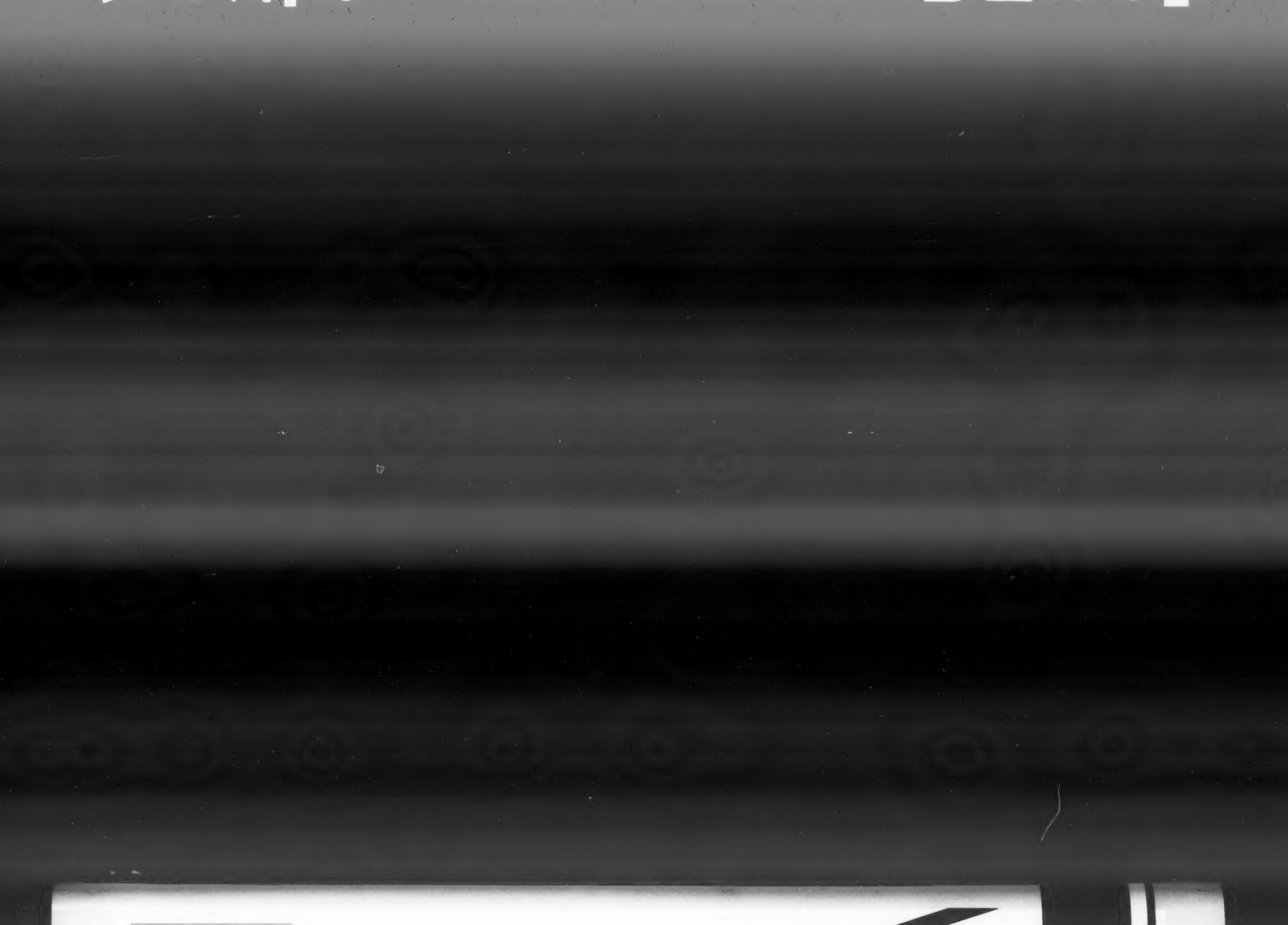

WILD-LIFE PORTRAITURE

(*Continued from page 348*)

mice, and among the subjects was a meadow mouse —a burrower who hates to be caught out in the open. I first tried to get him in position on a piece of sod with an overhanging grass background, but it was no go. As soon as I'd get him out of the grass on one side, he'd dive in again on the other. Finally I made an open-front box of wire screening; placed field stones on both sides and at the back, with no space behind in which to hide; set a short length of mailing tube between the side stones, facing the camera and about an inch out from the back; and covered the tube completely with mud and grass. At the mouth of the tube I made a narrow mud platform, on which the camera was focused. Then the mouse was placed at the back of the tube. He immediately ran inside to get out of sight. When he came out the other end and stopped to look around, flash went the lamp. After he'd been adequately recorded for posterity, the whole equipment was then covered with snow and served the same function for photographing a pine mouse. A lot of work? Sure it was, but the results could never have been attained by any other method.

Birds and beasts seldom do what you expect, at least when you're trying to get their pictures. The most beautiful setup in the world never seems to please them. You can provide the perfect setting for a mouse, the sort of place you know you'd enjoy if you were a mouse, and he'll always want to be somewhere else. As a consequence it's best to be prepared to make changes at a moment's notice. Instead of sitting on soft green moss at the base of a lichen-covered rock, he'll invariably prefer the top of the rock. Of course the top may provide an equally good setting, but you'll have to be ready to make a quick switch.

The same technique may also be used in other and less-confined situations. A bird feeding tray in winter offers almost unlimited possibilities. To get the birds coming, use any kind of a feeder you prefer, changing it later to an open tray to take pictures. Nail a branch to the side, crop off all portions outside the field of your camera, and then wait for a good pose. Of course you'll have to orient the tray for proper sunlight and make sure that the background is acceptable or else put in one of your own. Our Christmas tree got into a lot of pictures last winter as a deep-woods background. Chickadees will come in while you're standing out in the open, but for most other birds you'll need a blind. An old crate or almost any kind of cover will do, and using it is far more satisfactory than sitting inside the house and pulling a string, even if it may not be so comfortable.

After you've exhausted the possibilities of that particular perch, set up a pine branch with a fully opened cone properly located. Stuff the far side full of sunflower seeds, remove the rest of the seeds from the tray, and every bird will light in the right place. Another possibility is to set up a section of a tree trunk and stick the seeds in crevices in the bark or in a cavity. There are countless variations on this theme. Make certain of one thing, though: Give the birds (*Continued on page 350*)

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WILD-LIFE PORTRAITURE

(*Continued from page 349*)

speed and lots of it. At 1/50 of a second, you'll get only a blur. Even at 1/150 they'll quite often beat the shutter. The minimum is really 1/200, and since it's necessary to stop down as much as possible, a flash is often required. A General Electric No. 16 gives enough light for a speed of 1/200 at *f*:32.

Probably these illustrations have indicated sufficiently the problems involved in this branch of photography and some of the methods used in their solution. To cite more case histories might possibly be interesting but not necessarily helpful, since each presents individual difficulties which are never met in the same manner twice. There are countless other phases which have not been mentioned, mainly because they introduce no new procedures. They should not, however, be overlooked. It is an inescapable fact that the success of a photograph has not the slightest connection with the difficulties overcome in taking it. A well-composed flower study may have much more appeal than a shot of a charging elephant.

Just a word, then, about the simpler types which still present their problems — young birds, for example. Except for game and sea birds and the birds of prey, young birds are not very photogenic until they're fully feathered. A feeding shot at the nest is, of course, another matter, but I'm thinking now of the young birds themselves. When they're ready to leave the nest, they make excellent subjects, but the greatest care must be taken in handling them. If birds are taken from the nest before they're ready to leave of their own accord, they're apt to become dissatisfied with the old home and refuse to return to it, no matter how many times you replace them. The end can be only disaster, for they fall prey to cats or other predators in short order. A close watch must therefore be kept on the nest, and not until the birds actually start out for themselves should they be handled.

Flowers, the simplest of all subjects, require a bit of thought for best results. They seldom grow in locations which are ideal for photographic purposes. The backgrounds are usually unpleasing, the sun is rarely right, and even a slight breeze creates motion which requires a fairly wide-open lens. Whenever possible, I bring the flowers indoors. With small flowers the taking distance is relatively constant, the lighting (two photofloods) is a constant, and therefore the stop and exposure are known, so that after the first few exposures no further attention is needed from the mechanical standpoint. The necessity for guarding against confusing backgrounds is of paramount importance here, and the same considerations which have been previously stated apply. Dramatic, if not entirely natural, effects can be readily obtained by the use of extreme contrast. You won't want too many prints of this sort, but a few are most acceptable. Use a dead-black background and set in front of it a very few pieces of grass, pine, or something else which will give a subdued over-all pattern. Such a scheme is particularly effective with a white or light-colored flower. The print (*Concluded on page 352*)

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WILD-LIFE PORTRAITURE

(*Concluded from page 350*)

should merely suggest this background — keep it from being solid black. Natural backgrounds, such as field stones, stumps, and so on, are excellent in the right places — but don't forget they have to be right. This use of studio setups for flower photography is particularly helpful for color work. With three 3,200-degree Kelvin lamps (in case you're using Kodachrome) and stopping down to *f*:32, a speed of four and a half seconds is required. Even though you could get this same amount of light in the woods, one would rarely find a day still enough for such an exposure.

I haven't mentioned color shots until now. They're difficult to use indoors for animal subjects, as the same considerations of speed apply and if you pour enough light to allow for speeds of 1/100 of a second or better, the animals won't pose, and even if they do, they'll be squinting and unnatural. Frogs are easy enough. Occasionally one will leap off in the middle of a three-second exposure, but in general they'll co-operate. The recently introduced color-corrected flash lamps offer possibilities, particularly since they are supposedly balanced for daylight synchronization. For the few uses I have made of them, these lamps have been fairly successful and warrant further experimentation.

I started taking nature pictures some ten years ago because I found the field a tremendously fascinating one. I soon discovered there was very little competition among either amateur or professional photographers, and wondered a bit if there was something wrong with my make-up. Why didn't other people enjoy this type of photography, too? With the passage of years I have discovered they do. An amazing number of photographers try it but after a constant series of disappointments give it up and go back to buildings and babies. Patience, sometimes an inordinate amount of it, is an essential. The main troubles, however, seem to be a lack of knowledge of the creatures whose photographs are attempted and the assumption that the only method available is camera hunting. It is to these people that this article is addressed. May it give some of them inspiration to try again in the field of wild-life portraiture.

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MYTH AND METAL

(*Concluded from page 330*)

A modern interpretation of the story told in the *Eddas* is given by Matthew Arnold:

> . . . The final day
> When from the south shall march the fiery band
> And cross the bridge of Heaven, with Lok for guide
> And Fenris at his heel with broken chain;
> While from the east the giant Rymer steers
> His ship, and the great serpent makes to land;
> And all are marshall'd in one flaming square
> Against the Gods, upon the plains of Heaven. . . .

Tradition has it that not quite all the gods perished in this catastrophe — that a few survived, hidden from the Hallstatt peoples in the depths of the forest. The climate remained difficult for many years, however — cold and wet. The oak and beech forests were replaced by spruce. The bogs in Ireland deepened — witness the 26 feet of growth in the Donegal County bog — and the remains of the lakes dwellers' villages were submerged by the rising waters of the lakes. It is interesting that unusual drought in recent years has lowered the water level in some of these lakes, particularly in Switzerland, and exposed the remains of some of the long-hidden dwellings. During this wet, cold period, the seashore of western Europe gradually settled, submerging many of the great Bronze Age megalithic monuments, some of which in Brittany, as in the Scilly Isles, are visible today only at very low tide.

But gradually the climate changed for the better again, so that by the year 400 B.C., according to students of the subject, it had become very much less severe, and in northwestern Europe a new culture slowly grew up based on iron instead of bronze. The few remaining descendants of the Bronze Age could leave their forest fastnesses and start to build again a new civilization, as foreseen by the vala, or druidess, in the *Elder Edda:*

> She sees arise
> The second time,
> From the sea, the earth
> Completely green:
> Cascades do fall,
> The eagle soars,
> From lofty mounts
> Pursues its prey.
>
> The gods convene
> On Ida's plains. . . .
>
> The fields unsown
> Yield their growth;
> All ills cease. . . .

THE INSTITUTE GAZETTE

(*Continued from page 335*)

DEPARTMENT OF MILITARY SCIENCE AND TACTICS*

THE Committee find that the personnel of the Department are continuing the highly satisfactory standards of work that have prevailed in the past and are making earnest efforts to (*Concluded on page 354*)

* Members of this Committee for 1939–1940 are William E. R. Covell, '23, Chairman, Francis J. Chesterman, '05, Theodore B. Parker, '11, Lucas E. Schoonmaker, '17, Malvern-Hill Barnum, and Edward C. Harwood.

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THE INSTITUTE GAZETTE

(*Concluded from page 353*)

obtain even better results. The present enrollment, which is the War Department limit, is 326 students, as compared with the limit of 215 students two years ago. The increase was made possible by additional appropriations by Congress.

There are, however, a few problems which, if satisfactorily solved, would permit this Department to increase its utility both to the Institute and to the government. The first of these is the need for fireproof storage space for government equipment utilized by the Reserve Officers' Training Corps. The Committee recommend that the Institute give immediate consideration to this important matter. Although it is recognized that existing funds probably will not make possible the construction of suitable facilities in the immediate future, it is strongly urged that fireproof storage space for this equipment be placed, with high priority, on the schedule of new building for the Institute.

The present rifle range is unsatisfactory in that it is housed in a temporary frame building and has but five firing points. The large number of students who are required to take the course in rifle marksmanship should have a modern range and at least ten firing points. The Committee were pleased to find that these needed facilities are included in the building program of the Institute and recommend that they be continued thereon with their present high priority.

The difficulty and danger encountered by the R.O.T.C. students in crossing Massachusetts Avenue to and from military drill were discussed by the Committee. This problem would be obviated by the construction of an underground passageway. The Committee are cognizant of the cost and difficulties but recommend that the matter be not considered closed.

The mechanization of armies today and the traditional dependence of our country on a small regular army make it imperative that our War Department keep up with technological progression or even lead in those specialized fields pertaining directly to its work. This fact has been recognized by the government, and special boards, so called, have been set up in each branch of the Army, charged with the duty of keeping our defense forces abreast of scientific progress. The development by the Institute of closer relationships with industry, especially in connection with research projects, has led this Committee to consider the possibility of a parallel arrangement that would establish a closer relationship between Institute activities and these military research boards and other governmental agencies responsible for the national defense.

Active research by graduate and special research students has a stimulating effect both on instructors and on students in the undergraduate courses because it fosters recognition of the facts that our scientific knowledge is vital and growing and that there is still plenty of room for achievement. We believe that men of science and military men will benefit by a better understanding of each other's methods and views.

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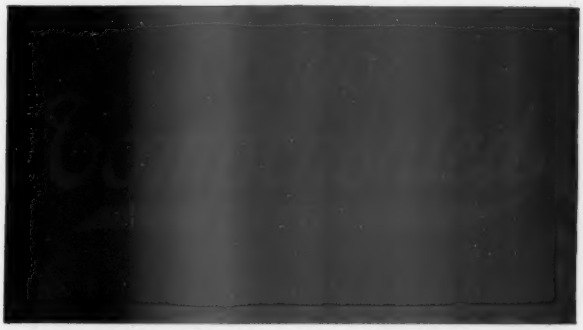
AN AID TO ALUMNI IN FINDING DESIRABLE POSITIONS

YOU GET A TWELVE-FOLD SAVING *from*



1 Ruptures in outside ply eliminated—because it is under the *same tension* as inside plies—therefore no "broken backs" to shorten belt service.

2 Freedom from ply separation—because plies under equal tension cling together and work as a team, each strengthening the others and therefore

3 Longer fastener life—because strain is uniform.

4 Can be operated on smaller pulleys—because plies are compensated for even tension and belt flexes naturally and easily without strain.

5 Less bearing, shafting and hanger troubles—because Condor Compensated with special low-tension surface,* can be run slack and still grip the pulley throughout the arc of contact.

6 For heavy loads, plies may be increased with same pulleys—because ply stresses, where belt flexes around the pulley, are borne equally by all plies.

7 Operation less affected by atmospheric conditions—because construction permits running belt at low tension.

8 Higher overload capacity or margin of safety—because of high coefficient of friction surface on pulley side, which keeps the belt gripping the pulley.

9 Less wear on pulley side—because belt may be operated at lower tension without increase in slip or creep and without "chatter."

10 Can be dressed without injury to belt—an important feature.

11 High production efficiency—because operation is uninterrupted by need for frequent "take-ups," pulled or broken fasteners or premature belt failure.

12 Material reduction in belting costs—because Condor Compensated lasts so long that it outearns its cost.

*Also available in Type F where rubber friction pulley surface is desired, and Type B where some slip is necessary.

If you want the details in picture and words, write for Bulletin 6808-C

Condor PRODUCTS

Conveyor and Elevator Belt
Transmission Belt
V-Belt
Air Hose
Contractors Hose
Fire Hose
Hydraulic Hose
Oil and Gasoline Hose
Sand Blast Hose
Steam Hose

Condor PRODUCTS

Suction Hose
Water Hose
Chute Lining
Launder Lining
Industrial Brake Blocks and Lining
Molded Rubber Goods
Rubber Lined Tanks
Rubber Covered Rolls

Abrasive Wheels
Bowling Balls

THE MANHATTAN RUBBER MFG. DIVISION
OF RAYBESTOS-MANHATTAN, INC.
EXECUTIVE OFFICES AND FACTORIES
PASSAIC, N. J.

Thomas H. Boyd, '23 Wilder E. Perkins, '25 Charles P. McHugh, '26 Daniel J. Hanlon, '37 Robert Tischbein, '38

25 YEARS AGO

1915

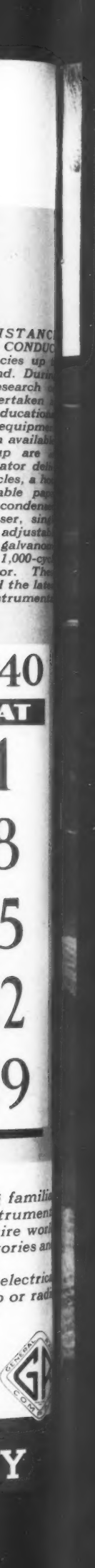
SKIN-EFFECT RESISTANC MEASUREMENTS OF CONDUC TORS at radio frequencies up 100,000 cycles per second. Duri 1915–1916 important research this problem was undertaken one of the leading educatio institutions with the equipme shown — the latest then availab Included in the set-up are Alexanderson r-f alternator deli ering 2 kw at 100,000 cycles, a ho wire ammeter, adjustable pa condenser, variable air condens fixed telephone condenser, sin slide-wire, fixed and adjusta inductances, a portable galvano eter, a headset and 1,000-cyc commutator interruptor. The instruments represented the late developments in the instrumen tion field in 1915.

1940

TWENTY-FIVE YEARS LATER the same measurements can be duplicated with this equipment at frequencies up to 1,000,000 cycles per second and with accuracies far in excess of those possible in 1915. Included are General Radio Type 516-C Radio Frequency Bridge, Type 684-A Modulated Oscillator, Type 619-E Heterodyne Detector, Type 663 Resistors and a headset. Before 1940 has gone by G-R instruments will probably be available to extend the frequency range of these measurements to 10,000,000 cycles!

GENERAL RADIO COMPANY celebrates its 25th Anniversary this month. The twenty-fifth year in the life of most companies or persons is not particularly significant; but in the radio and electronic measuring-apparatus field twenty-five years takes one practically back to the beginning. General Radio is probably the oldest company of its kind in the world. It has been continuously engaged (under the same name, with the same directing head and with the same managerial policy) in the design, manufacture and sale of precision electrical laboratory apparatus for use at communication frequencies. General Radio instruments have always kept abreast of the developments in the electronic art and its apparatus has in no small measure contributed to the ease with which further developments have been and are possible.

The extent of diversification in the manufacture of its apparatus is always surprising to persons not long famili with General Radio. G-R instrumen are in use throughout the entire wor in the leading laboratories, factories an commercial organizations.

If you are interested in electric measuring equipment at audio or radi frequencies, you should familiarize yourself in detail with G-R products. Write for Catalog K. Address 30 State Street, Cambridge, Mass.

GENERAL RADIO COMPANY